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MYCOTAXON

AN INTERNATIONAL JOURNAL DESIGNED TO EXPEDITE PUBLICATION
OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

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Volume XVI October-December 1982 No. 1

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MYCOTAXON

Vol. XVI, No. 1, pp. 1-34 October-December 1982

A PRELIMINARY DISCOMYCETE FLORA OF MACARONESIA: PART 5, SCLEROTINIACEAE*

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> "Extreme remedies are very appropriate for extreme diseases."
> Hippocrates [tr. William Henry Rich Jones]
> APHORISMS, Sect. I, 6

Order HELOTIALES
Suborder HYMENOSCYPHINEAE
Family SCLEROTINIACEAE Whetzel 1945

KEY TO THE KNOWN MACARONESIAN GENERA

1. Apothecia cupulate, stipitate, on a distinct sclerotium with a well-differentiated rind and medulla ..2
1'. Apothecia cupulate, stipitate, on a substratal stroma, or stroma lacking (but if lacking, often with melanized cells at base of stipe) 3

    2(1). Sclerotial medulla enveloping suscept tissues ....**Ciborinia**
    2'(1). Sclerotial medulla free of suscept tissues. **Sclerotinia**

3(1'). Ascospores brown at maturity ....**Lambertella**
3'(1'). Ascospores hyaline at maturity 4

    4(3'). Ectal excipulum composed of prosenchymatous cells bound in gel ....**Poculum**
    4'(3'). Ectal excipulum composed of short cells, not bound in gel 5

---

* The parts of this flora will appear in irregular order. Reprints of individual parts will not be available for distribution.

5(4'). Ectal excipulum composed of brick-shaped cells. **Lanzia**

5'(4'). Ectal excipulum composed of globose cells 6

- 6(5'). Lignicolous; ascospores greater than 10 µm long ....**Ciboria**
- 6'(5'). Foliicolous, on herbaceous stems, or on mummified fruits; ascospores less than 10 µm long ....**Moellerodiscus**

Some taxa are identified here by the specimen number of a "typical representative," either because our collections are too scanty to serve as types, or because there are no comprehensive monographs of Sclerotiniaceous genera such as Ciboria, Lanzia, Moellerodiscus, and Poculum; too often type species are themselves doubtful.

CIBORIA Fuckel 1870

Key to the known Macaronesian species

1. Asci 4-spored, ascospores bearing a gel sheath. **1. Ciboria sp. 254**

1'. Asci 8-spored, ascospores without a gel sheath 2

- 2(1'). Ascospores (11.7-) 13.7-18.6 x 5.8-6.4 µm **3. Ciboria sp. 1182**
- 2'(1'). Ascospores 8.8-11.0 (-13.2) x (2.9-) 3.0-3.7 (-4.4) µm .....**2. Ciboria sp. 573**

1. Ciboria sp. 254

RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

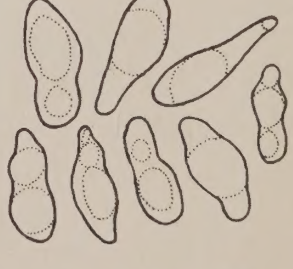
KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.

Tenerife. CUP-MM 254.

SUBSTRATUM: On twig.

Notes: This sparse collection is too meagre to constitute a type specimen. Although the tissue structure of the apothecia, composed of textura globulosa bound in gel, suggets affinities in Moellerodiscus, the substrate,



Ciboria sp. 254, 8 ascospores, CUP-MM 254, x 1000.

an unidentified twig, is anomalous for that foliicolous genus. There is no trace of a stroma except for some darkly pigmented cells at the base of the stipe. The asci are J+ and 4-spored. Ascospores are variable in shape, from irregularly ellipsoid to pyriform, though most frequently they are "slipper-shaped," uni- or biguttulate, (10.5-) 11.0-14.6 x 3.7-4.4 µm. Spore germination on water agar is uni- or bipolar.

2. Ciboria sp. 573

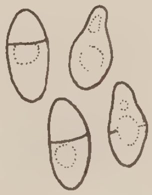
RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.
Tenerife. CUP-MM 573.

SUBSTRATUM: On branchlet in stream.



Ciboria sp. 573, 4 ascospores, CUP-MM 573, x 1000.

Notes: This small lignicolous collection also shows affinities in Moellerodiscus primarily on the basis of the microanatomy of the ectal excipulum, in this fungus composed of textura globulosa not bound in gel. Except for dark-walled cells at the base of the stipe, no stroma is evident. The asci are 8-spored and the pore J+. The ascospores are one- and two-celled, uni- or biguttulate, ellipsoid to fusoid to lacriform, 8.8-11.0 (-13.2) x (2.9-) 3.0-3.7 (-4.4) µm.

3. Ciboria sp. 1182

RECENT TAXONOMIC TREATMENTS: None.

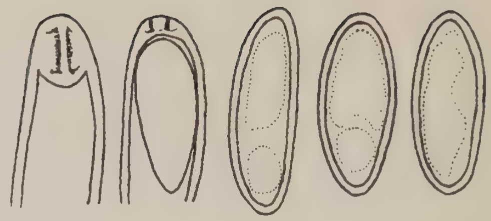
PREVIOUS MACARONESIAN RECORDS: None.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.
Tenerife. CUP-MM 1182.

SUBSTRATUM: On wood.

Notes: APOTHECIA scattered, arising from wood; turbinate, buff, concolorous; disc up to 1.5 mm in diam tapering to form a short stipe. ECTAL EXCIPULUM up to 80 µm wide along flanks and stipe, narrower at the margin, composed of hyaline textura globulosa arranged in chains perpendicular to the hymenial surface, cells up to 15 µm in diam, most cells under 10 µm, at margin composed of textura prismatica in chains parallel to asci. MEDULLARY EXCIPULUM a compact layer of hyaline textura intricata possibly bound in gel, cells up to 2.0 µm wide; medullary zone of stipe a compact textura porrecta oriented parallel to the stipe axis. SUBHYMENIUM poorly differentiated. ASCI clavate-cylindrical, 120-178 x 9-12 µm, apices thickened (up to 6.0 µm), pore channel walls strongly J+, 8-spored. ASCOSPORES hyaline, obliquely uniseriate, ellipsoid to allantoid, bi- or multiguttulate in youth, becoming one-septate, (11.7-) 13.7-18.6 x 5.8-6.4 µm. PARAPHYSES cylindrical, simple, septate, 1.0 µm wide, slightly inflated at the apices to 2.0 µm, not exceeding the asci.



Ciboria sp. 1182, apices of 2 asci, 4 ascospores, CUP-MM 1182, x 1000.

This description is based on a small collection. The turbinate apothecia and also the aseptate ascospores suggest this sparse material is also immature. No true stroma is in evidence; microscopically, the tissue subtending the base of the stipe is composed of host cells filled with hyaline hyphae. The apothecial microanatomy is most like that of *Ciboria peckiana* (Cooke) Korf although the spores in this collection are smaller and the apothecia (as we have them here) are much different macroscopically. This collection differs from *Poculum firmum* (Pers. : Fr.) Dumont, also on wood, in having an ectal excipulum composed of globose cells.

CIBORINIA Whetzel 1945

Key to the known Macaronesian species

1. Ascospores 10.6-13.8 x 4.8-6.4 µm, biguttulate, with a prominent gel sheath **1. Ciborinia sp. 1466**

1'. Ascospores (1.8-) 4.8-8.8 x (1.8-) 2.6-3.1 (-4.8) µm, usually eguttulate, without a gel sheath. **2. C. hirsuta**

1. Ciborinia sp. 1466

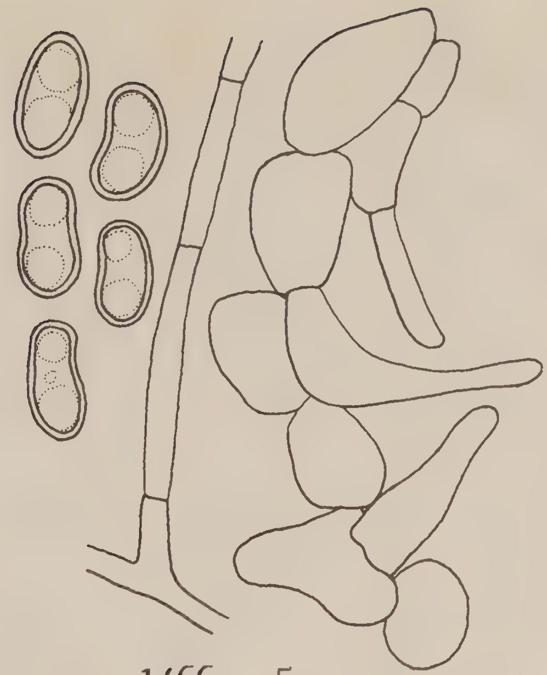
RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.
Hierro. CUP-MM 1466.

SUBSTRATA: On sclerotia free in soil or attached to debris.



Ciborinia sp. 1466, 5 ascospores, brown-walled, rhizoidal hair from base of stipe, section through flank of apothecium showing outermost cells and tomentum hyphae, CUP-MM 1466, x 1000.

Notes: APOTHECIA solitary from tuberoid sclerotia; disc 0.9-1.1 mm in diam, hymenium buff, concolorous with excipular surface; stipe up to 5 mm long, 0.1 mm wide, reddish brown darkening to chestnut at the base. ECTAL EXCIPULUM 55-148 µm wide, of hyaline, thin-walled textura globulosa originating from cells of the medullary excipulum which "turn out" at a low angle to the surface and intergrade into the chains of globose cells perpendicular to the flank surface, cells up to 20 µm in diam with the largest cells along flanks; at margin outermost cells giving rise to some short tomentum hyphae; ectal excipulum of stipe composed of light brown-walled, finely superficially roughened textura porrecta, the outermost cells at the base of the stipe giving rise to brown-walled rhizoidal hairs. MEDULLARY EXCIPULUM up to 24 µm wide, narrowing toward the margin, of hyaline, thin-walled textura intricata, cells 4.0-6.5 µm broad; stipe medulla composed of hyaline, thin-walled textura intricata. SUBHYMENIUM 10.5 µm wide, a compact zone of light brown-walled textura intricata bound in gel, cells 2-3 µm broad. ASCI arising from croziers, columnar, 91-136 x 6.5-9.0 µm, pore faintly J+, asci containing a substance along the inside wall turning purple in Melzer's reagent, ascus apices thickened (3.5-4.5 µm thick), 8-spored. ASCOSPORES uniseriate, ellipsoid to allantoid to subreniform, (10.6-) 12.0 (-13.8) x 4.8-6.4 µm, biguttulate, with a prominent gel sheath (easily seen in Melzer's reagent). PARAPHYSES simple, septate, filiform, slightly enlarged at the tips, 1.0 µm wide, not exceeding asci. STROMA consisting of tuberoid sclerotia, spherical with an irregular depression on dorsal surface, firmly attached to the host on ventral surface, 0.75-1.0 mm in diam; medulla of textura oblita with very heavily gelatinized walls, enveloping host vessel elements near site of attachment to host tissue.

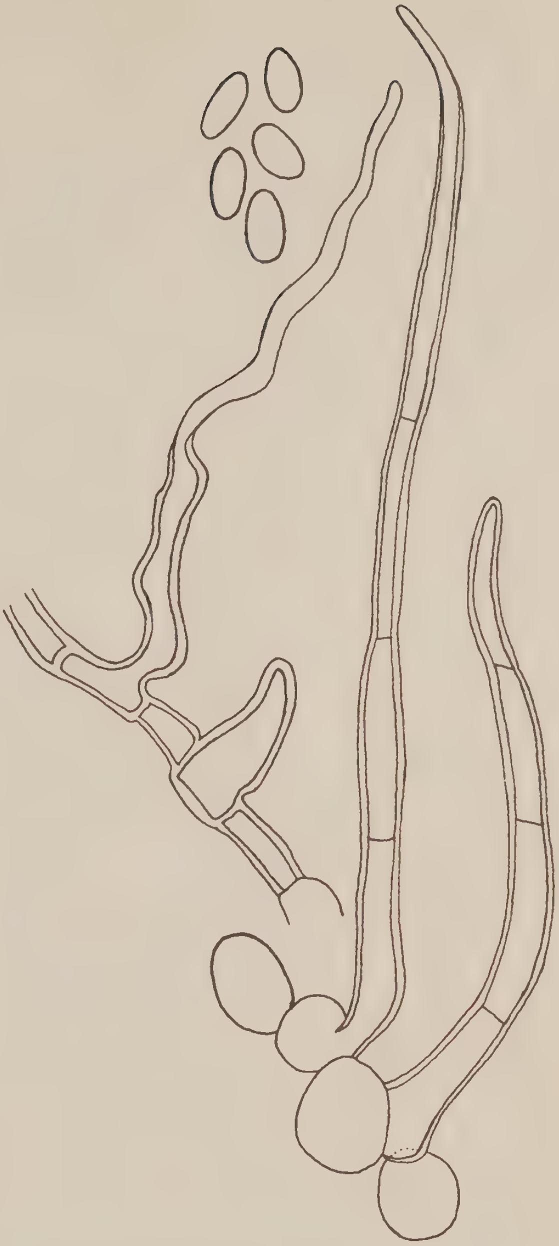
The subreniform ascospores with gel sheaths and the purple reaction of the inner ascus wall in Melzer's reagent distinguish this small but interesting collection. Neither sclerotial nor _Botrytis_ anamorphs were produced in cultures on DIFCO Corn Meal Agar, resulting in the assignment here to _Ciborinia_ rather than _Botryotinia_, which was our field identification.

2. **Ciborinia HIRSUTA** Kohn & Korf, **sp. nov.**

RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

Apothecia solitaria ex sclerotiis; discus rubrobrunneus, griseo-puberulentus, juventute crateriformis, deinde (sed non profunde) cupulatus, 1-2 mm in diam., stipite variabiliter ad 1 cm longitudine, ad 250 µ latitudine. Excipulum ectale ex cellulis formatum hyalinis, parietibus tenuibus praeditis, inflato-lateriformibus vel globosis, ordinatis in catenis 3-6 cellularibus ad superficiem perpendicularibus, cellulis ad 15 µ latis, eis extimis pilos saepe parientibus. Pili hyalini praebentes 3 formas fortasse gradus in progressu referentes: tomenti hyphas 1-2-cellulares ad 30 µ longas cellulis apicalibus clavatis instructas; pilos simplices multiseptatos columnares vel acuminatos ad 70 µ longos; pilos multiseptatos columnares vel acuminatos ad 100 µ longos, basi saepe ramosus. Asci ex crocis exorientes, cylindrici, 56-75 x 5-6 µ, pori canalis pariete J+, apicibus incrassatis. Ascosporae uniseriatae, hyalinae, plerumque eguttulatae, late ellipsoideae, in magnitudine valdissime variabiles, (1.8-) 4.8-7.0 (-8.8) x (1.8-) 2.6-3.1 (-4.8) µ; asci ex apotheciis sub conditionibus naturalibus collectis segregationem ascosporarum minorum (4.8-5.3 x 3.5-4.0 µ) et majorum (5.7-7.0 x 2.6-3.1 µ) in rationibus 4:4, 6:2, 8:0 praebentes. Stroma sub conditionibus naturalibus sclerotium discretum ovale ca. 1-1.5 mm longum, elevatum sed siccitate collapsum; cortex superficiem et dorsalum et ventralem involvens, crassitie 1-2 cellularum, ex textura globulosa formatum, parietibus brunneis, eis exterioribus densius atratis; medulla ex textura oblita parietibus gelatinosis ex parte formata, hospitis telae vestigia includens.



Ciborinia hirsuta, 5 ascospores, non-septate hairs emerging from the outermost cells of the stipe, multiseptate hairs originating from the flanks, CUP-MM 2273, x 1000.

APOTHECIA solitary from sclerotia, disc reddish brown, greyish-puberulent, goblet-shaped in youth, becoming shallowly cupulate, disc 1-2 mm in diam (apothecia produced *in vitro* larger than those collected in nature), stipe variable in length up to ca. 1 cm, 250 µm wide. ECTAL EXCIPULUM up to 35 µm wide along flanks, of hyaline, thin-walled, inflated, brick-shaped to globose cells arranged in chains 3 to 6 cells long, perpendicular to the flank surface, cells up to 15 µm broad, the outermost cells frequently giving rise to a smaller, globose cell (up to 10 µm in diam) in turn giving rise to hairs. HAIRS of three types possibly representing three phases of development: a one- to two-celled, hyaline tomentum hypha up to 30 µm long, with a clavate apical cell; a multiseptate, columnar to acuminate (but blunt-tipped) hair up to 5 µm broad and 70 µm long; a long, multiseptate, columnar to acuminate hair, often branched at the base, up to 100 µm long. MEDULLARY EXCIPULUM of two zones: the outer zone of thin-walled, hyaline textura intricata to textura prismatica with cells somewhat inflated, oriented parallel with the flank surface, giving rise to the inflated cells of the ectal excipulum, cells up to 14 µm broad; the inner zone composed of thin-walled, hyaline to light brown-walled, superficially granularly roughened textura porrecta oriented parallel to the hymenial surface, intergrading into textura intricata above stipe, cells 4-7 µm broad. SUBHYMENIUM a compact light brown textura intricata, cells 2.5-4.2 µm broad. ASCI arising from croziers, cylindrical, 56-75 x 5.0-5.8 µm, pore channel walls J+, apices thickened. ASCOSPORES uniseriate, hyaline, usually eguttulate, broadly ellipsoid, extremely variable in size, (1.8-) 4.8-7.0 (-8.8) x (1.8-) 2.6-3.1 (-4.8) µm; asci from apothecia collected in the field showing segregation of small ascospores (4.8-5.3 x 3.5-4.0) and large ascospores (5.7-7.0 x 2.6-3.1 µm) in 4:4, 6:2, and 8:0 ratios, with large ascospores often the basal ones in the chain of ascospores; asci from apothecia produced in vitro showing no segregation of large and small ascospores, producing irregular numbers of ascospores (up to 9 per ascus), ascospores iregular in size, some appearing to abort. PARAPHYSES filiform, simple, 0.8-1.0 µm wide, not exceeding asci. STIPE ectal excipulum of hyaline to brown, thin-walled textura porrecta with outermost cells somewhat inflated and giving rise to hairs as described for the receptacle and to much shorter, nonseptate to multiseptate, narrower hairs (25-30 x 2 µm) the contents of which stain deeply in phloxine/KOH; medullary excipulum of thin-walled, hyaline textura porrecta, becoming brown-walled at base of stipe, oriented parallel to stipe axis, cells 3-10 µm broad. STROMA in nature discrete oval sclerotia, ca. 1-1.5 mm long, raised, but collapsing on drying, brittle; rind enveloping both dorsal and ventral surfaces, one to two cells thick, of brown-walled textura globulosa, with the outer walls more heavily melanized, cells 7-10 µm in diam; medulla in two zones, the inner zone of hyaline, thin-walled textura intricata enveloping host vessel elements and incorporating some amorphous material, presumably remnants of digested host tissue, cells 4-5 µm broad; the outer zone composed of hyaline textura oblita with shorter cells than those in the inner zone and with thick, gelatinized walls, up to 5 µm thick where two adjacent walls coalesce.

CULTURE: Ascospores of CUP-MM 2273 were germinated in mass on DIFCO Potato Dextrose Agar. Cultures were taken from the field to Cornell University, where they were transferred to 9 cm plastic petri dishes containing DIFCO Malt Agar, DIFCO Low pH Mycological Agar, and DIFCO High pH Mycological Agar. After three weeks of incubation at room temperature under ambient light conditions, large (0.5-2 cm long), discrete sclerotia were formed on malt agar, small sclerotia on Low pH agar, and no sclerotia on High pH agar; all cultures produced thick mats of white mycelium bearing a *Myrioconium* "microconidial" anamorph. In an attempt to induce formation of a conidial anamorph, cultures were incubated in a growth chamber at 15 C under ca. 21,000 lux mixed incandescent and flourescent light. While no conidial anamorph was produced, after approximately two months apothecia developed in the cultures on malt agar. Subsequent microanatomical study of the sclerotia showed marked dorsiventral differentiation; the dorsal rind is similar to that described from sclerotia found in nature, but the ventral rind is composed of a loose weft of dark brown-walled prosenchyma. The medulla is composed of textura oblita with thick, gelatinized walls, but is loosely interwoven in the area adjacent to the ventral rind. The entire sclerotium produced in culture is overlaid by a thick layer of white mycelium incorporating rhomboidal crystals and sporodochia of the *Myrioconium* anamorph.

HOLOTYPE: R.P. Korf, L.M. Kohn, N. Korf & A.Y. Rossman, under *Vaccinium*, Ribeiro Frio, Madeira, Portugal, 21.iv.1978. (CUP-MM 2273).

KNOWN MACARONESIAN DISTRIBUTION

MADEIRA.

Madeira. CUP-MM 2272, 2273 (holotype), 2349.

SUBSTRATA: Under *Vaccinium* (CUP-MM 2273, 2349); under lily (Liliaceae) (CUP-MM 2272).

Notes: On making these collections under *Vaccinium* and a lily in late spring, our initial identification as a species of *Botryotinia* awaited only development of a *Botrytis* conidial anamorph in cultures made from ascospores. Subsequent cultural studies have failed to yield a *Botrytis* anamorph, or any other conidial anamorph save the *Myrioconium* "microconidial" state ubiquitous among members of the Sclerotiniaceae. This species is consequently accommodated in the genus *Cibo-*

rinia, where it is described as new. Future collections of this species may establish the host/substrate relationship more clearly; unfortunately the host material in these collections is fragmentary and well-decayed.

LAMBERTELLA von Höhnel 1918

Key to the known Macaronesian species

1. On dead branches of Myrica faya ....2. **L. myricae**
1'. On other hosts 2

2(1'). Ascospores finely punctate, banded. 1. **L. corni-maris**
2'(1'). Ascospores not ornamented, not banded ..3

3(2'). Apothecia bearing bulbous-based hairs with acuminate tips ....3. **L. zeylanica**
3'(2'). Apothecia not bearing such hairs 4

4(3'). Ascospores 13.3–16.1 x 3.7–5.9 µm, without a gel sheath 4. **Lambertella sp. 1734**
4'(3'). Ascospores 8.0–9.5 x 3.2–4.2 µm, with a gel sheath .....5. **Lambertella sp. 1959**

1. **Lambertella corni-maris** Höhn., Sitzungsber. Kaiserl. Akad. Wiss., Math.-Naturwiss. Kl., Abt. 1, **127**: 375. 1918.

RECENT TAXONOMIC TREATMENTS: Dumont (1971).

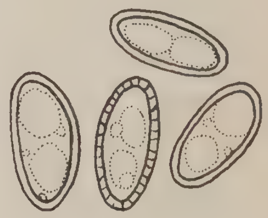
PREVIOUS MACARONESIAN RECORDS: None.

TYPE LOCALITY: Austria.

KNOWN MACARONESIAN DISTRIBUTION
CANARY ISLANDS.
La Palma. CUP-MM 671.

SUBSTRATUM: unidentified petiole.

Notes: Ascospores were yellow-brown and germinated on water agar by single germ tubes in 24 hrs.



L. corni-maris, 4 ascospores, CUP-MM 671, x 1000.

2. **Lambertella myricae** Dennis & Spooner in Dennis, Reid and Spooner, Kew Bull. **32**: 113. 1977.

RECENT TAXONOMIC TREATMENTS: Dennis & al. (1977).

PREVIOUS MACARONESIAN RECORDS: *Dennis & al. (1977).

KNOWN MACARONESIAN DISTRIBUTION

*AZORES.
***Terceira.** *Dennis & al., 26.iii.75 n.v.

SUBSTRATUM: Dead branch of Myrica faya Ait.

Notes: The type (only known) specimen was not available to us from Kew, where it is on deposit, since it had already been studied and annotated by Dr. K.P. Dumont at the New York Botanical Garden. Kew did not provide copies of his notes for our examination. Using the description and illustration of Dennis & al. (1977) and Dumont's (1971) classification, it would key out as L. viburni Whetzel & Dumont in Dumont. Dennis & al. note their species to be "evidently very close" to L. viburni.

3. **Lambertella** cfr. **zeylanica** Dumont, Mem. New York Bot. Gard. **22**: 167. 1971.

RECENT TAXONOMIC TREATMENTS: Dumont (1971).

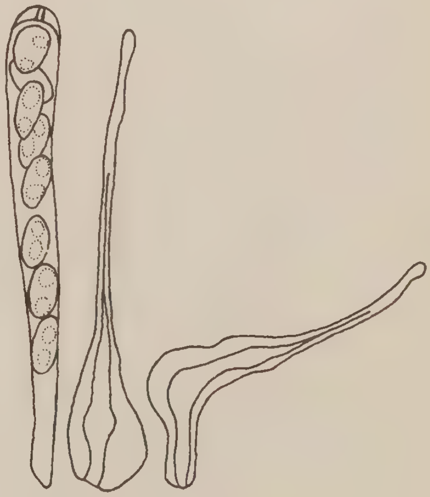
PREVIOUS MACARONESIAN RECORDS: None.

TYPE LOCALITY: Ceylon.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.
Tenerife. CUP-MM 410.

SUBSTRATUM: On leaf blade.



Lambertella cfr. **zeylanica**, ascus with ascospores, 2 hairs from flank, CUP-MM 410, x 1000.

Notes: As in the type collection of *Lambertella zeylanica*, there are no brown ascospores within asci in this small collection. Having examined the holotype of *L. zeylanica* (CUP-SA 3215), we find the size of the hyaline spores in CUP-MM 410 similar to the hyaline spores in that type. The larger, brown, discharged ascospores in the type collection were not seen in our collection from Tenerife. The acuminate hairs borne on the apothecial flanks in CUP-MM 410 have much thicker walls than those in CUP-SA 3215 and some collapse of cell lumen is evident in phloxine/KOH mounts. Our determination can only be provisional.

4. Lambertella sp. 1734

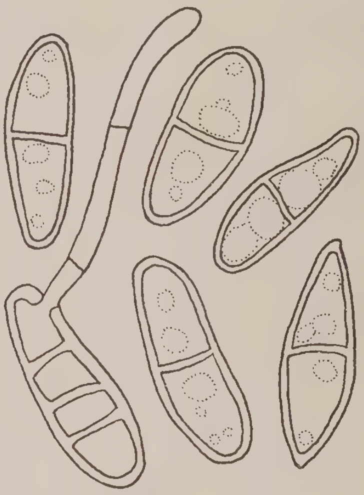
RECENT TAXONOMIC TREATMENTS:
None.

PREVIOUS MACARONESIAN RECORDS:
None.

KNOWN MACARONESIAN DISTRIBUTION

AZORES.
São Miguel. CUP-MM 1734.

SUBSTRATUM: On *Rubus* sp. in spray.



Lambertella sp. 1734 1-septate hyaline ascospores and 3-septate, pale brown-walled germinating ascospore, CUP-MM 1734, x 1000.

Notes: APOTHECIA scattered; disc shallowly concave in youth, at maturity plane to somewhat convex, up to 1.3 mm in diam; hymenium warm reddish brown, margin darker than hymenium, somewhat raised, exciple concolorous; stipe concolorous with disc, 0.5 x 13 mm. STROMA an indeterminate blackened area; no stromatic cells were observed in sections. ECTAL EXCIPULUM up to 35 µm wide along flanks, of hyaline textura angularis to textura globulosa, cells up to 20 µm in diam, zone narrowing at margin and there composed of occasionally inflated textura prismatica; stipe of same tissue types as flanks, with fine, hyaline hairs produced at the base. MEDULLARY EXCIPULUM up to 328 µm wide at flanks, of hyaline textura intricata, cells 2-3 µm wide, stipe of hyaline textura porrecta oriented parallel to stipe axis, cells 2-3 µm wide. SUBHYMENIUM poorly differentiated. ASCI arising from croziers, clavate, 80-85 x 7-10 µm, ascus pore channel strongly J+, apices thickened (2-3 µm), 8-spored. ASCOSPORES biseriate at first, then biseriate above and uniseriate below, finally uniseriate and filling most of the ascus, fusoid-ellipsoid with one or both ends tapering, 13.3-16.1 x 3.7-5.9 µm, one-septate and hyaline within asci, pale brown and 3-septate at germination. PARAPHYSES filiform, once-brn]anched, septate, 1.5 µm broad, not exceeding asci.

Although no brown ascospores were observed within asci, after discharge, at germination, ascospores become pale brown and three-septate. The ectal excipulum is composed of textura angularis with cells inflated but not quite globose. Apothecia do not appear to arise from a stroma, though the host surface is blackened; the blackened areas seem to be a rather superficial crust, with no stromatal cells in evidence at the junction of stipe and host. The brown-walled ascospores and subciborioid exciple suggest affinities in *Lambertella*, though this fungus does not fully conform to any species circumscription in that genus.

5. Lambertella sp. 1959

RECENT TAXONOMIC TREATMENTS: None.

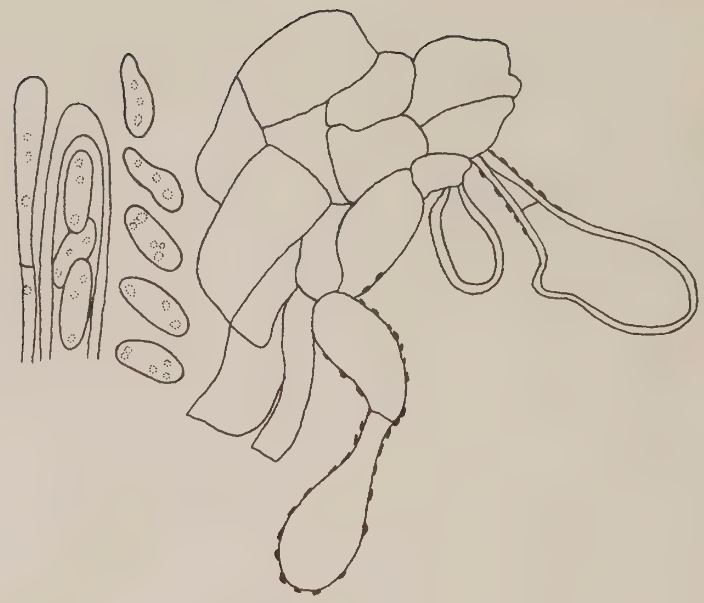
PREVIOUS MACARONESIAN RECORDS: None.

KNOWN MACARONESIAN DISTRIBUTION

AZORES.
Terceira. CUP-MM 1959.
MADEIRA.
Madeira. CUP-MM 2355.

SUBSTRATA: On capsules of *Eucalyptus* spp.

Notes: APOTHECIA scattered, stipitate-cupulate, disc 2 mm in diam, hymenium umber, exciple darker ochraceous brown; stipe variable in length, up to 2 mm long, tortuous, ochraceous brown, bearing short hairs, dark brown at base. STROMA not observed on the host, the thick, waxy cuticle of the capsule ruptured only at the site of stipe attachment; the stipe base, composed of a medulla of textura intricata-textura oblita with gelatinized walls, enveloped by an ectal excipulum of dark brown-walled textura globulosa, may constitute the stroma. ECTAL EXCIPULUM 60 µm wide at the flanks,



Lambertella sp. 1959, paraphysis, ascus apex, 8 ascospores, section through flank of apothecium showing outermost cells of ectal excipulum giving rise to hairs, CUP-MM 1959, x 1000.

of pale brown-walled, minutely granularly roughened textura prismatica with cells somewhat inflated (barrel-shaped), at flanks cells arranged in chains perpendicular to face of receptacle, towards margin chains of cells at a more acute angle to the surface, cells up to 26.5 x 8.0 µm, outermost cells giving rise to hyaline to pale brown-walled, 2-3-celled, occasionally granularly roughened hairs up to 35 µm long, bearing a clavate, sometimes thick-walled apical cell; margin of dark brown-walled textura prismatica in chains at a low angle to the excipular surface, cells up to 5 µm broad. MEDULLARY EXCIPULUM a compact zone, up to 85 µm wide, of superficially granularly roughened, hyaline textura intricata, cells 2.7-5.3 µm broad. SUBHYMENIUM 48 µm wide, composed of hyaline, granularly roughened textura intricata, cells 1.6-2.7 µm broad. ASCI arising from croziers, clavate, (60-) 70-78 x (5.8-) 7.0-8.0 µm, pore channel wall J+, apices thickened (up to 4.2 µm), 8-spored. ASCOSPORES uniseriate (occasionally partially biseriate), narrowly ellipsoid to reniform to lacryform, 8.0-9.5 x 3.2-4.2 µm, hyaline within asci, golden brown at germination, bi- to multiguttulate, bearing a prominent gel sheath up to 0.5 µm thick. PARAPHYSES filiform, simple, septate, up to 1 µm broad at apices, not exceeding asci. STIPE: ectal excipulum 3-4 cells thick, of brown-walled, brick-shaped to subglobose cells oriented parallel to stipe axis, cells up to 8 µm broad, outermost cells occasionally giving rise to clavate, 1-2-celled hairs 20-25 µm long; medullary excipulum of hyaline, thin-walled, superficially granularly roughened textura porrecta oriented more or less parallel to the stipe axis.

CUP-MM 2355, also on capsules of Eucalyptus but collected in Madeira, is similar to CUP-MM 1959 from the Azores, upon which this description is based, but differs in several important respects: (1) the apothecia are smaller (ca. 1 mm in diam), less robust, and grey when dry, though warm brown when rehydrated; (2) the cells of the excipulum are shorter, narrower, and except for the hairs are oriented parallel to the excipular surface; (3) the ascospores are larger (10 x 3 µm) and regularly biguttulate. Since both collections are small, it is questionable whether these differences fall within the range of variation of one species or serve to separate two distinct species.

LANZIA Saccardo 1884

Key to the known Macaronesian species

1. Asci 8-spored; on husks of Castanea .... **1. Lanzia sp. 137**
1'. Asci 4-spored; on leaf blade. **2. Lanzia sp. 409**

1. Lanzia sp. 137

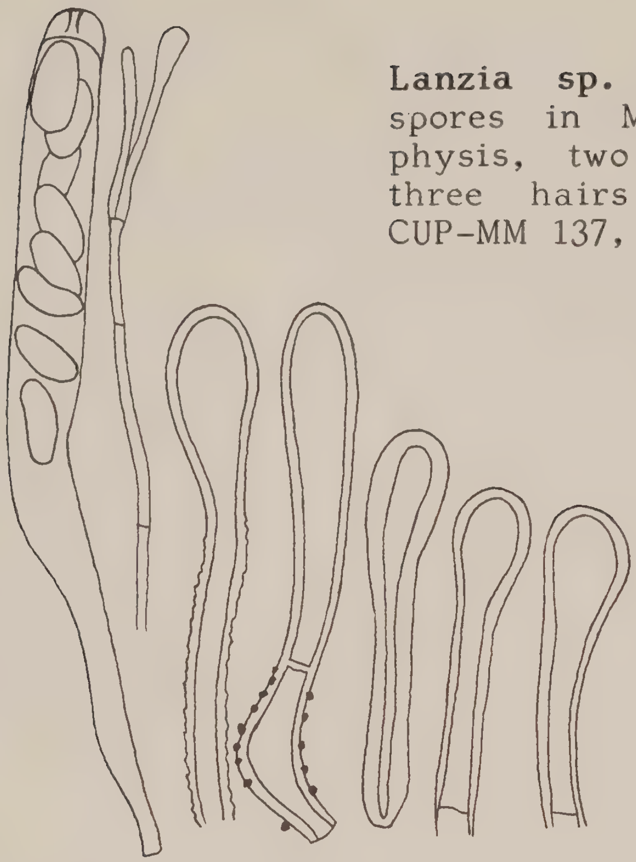
RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

KNOWN MACARONESIAN DISTRIBUTION:
CANARY ISLANDS.
Tenerife. CUP-MM 137.

SUBSTRATUM: On needles of the husks of Castanea sativa Mill.

Notes: APOTHECIA solitary, associated with stromatized patches on the host, deeply cupulate in youth, becoming



Lanzia sp. 137, ascus and ascospores in Melzer's reagent, paraphysis, two hairs from the stipe, three hairs from apothecial flank, CUP-MM 137, x 1000.

shallowly cupulate at maturity; disc reddish brown, up to 0.75 mm in diam; stipe reddish brown, black toward the base, up to 1 mm long. ECTAL EXCIPULUM composed of two zones: an outer zone 3-4 cells thick of hyaline to light brown-walled, occasionally granularly roughened, brick-shaped cells 3-6 µm broad, the outermost cells giving rise to hyaline to light brown-walled, septate hairs 20-40 µm long usually terminating in a clavate cell; the inner zone 20-30 µm wide, tapering off at the margin, of hyaline to light brown-walled brick-shaped to inflated (more or less globose) cells which are up to 10 µm in diam; ectal excipulum of the stipe composed of brick-shaped, brown-walled, granularly roughened cells oriented parallel to the stipe axis, cells up to 5 µm broad, outermost cells occasionally giving rise to one- to multicelled tomentum hyphae, cells at base of stipe globose, up to 10 µm in diam, with thick, brown walls. MEDULLARY EXCIPULUM a loose layer ca. 60 µm wide at flanks, of hyaline to light brown-walled textura intricata, coarsely granularly roughened, cells up to 7 µm broad; stipe of brown-walled, coarsely granularly roughened prosenchyma oriented parallel to the stipe axis, graduating into a compact textura intricata at the stipe base. SUBHYMENIUM a compact layer 25 µm wide of hyaline textura intricata, cells 1-2 µm broad. ASCI arising from croziers, 40-60 x 6-7 µm, clavate, apices thickened (up to 3 µm), J+ with ascus pore channel wall turning pale blue (darker blue below and appearing as a dark blue ring or as two dots at the pore channel base), 8-spored. ASCOSPORES uni- or biseriate, hyaline, ovoid-ellipsoid, 7-9 (-10) x (2-) 3 (-4) µm, minutely biguttulate. PARAPHYSES filiform or with apices slightly swollen, 1 µm broad, simple or branched, septate, not exceeding asci. STROMA possibly limited to stipe base; stromatized patches on host of doubtful relationship to apothecia.

Unfortunately the collection upon which this description is based is too small to constitute a type specimen. We would have dedicated the new species to J. T. Palmer, whose research on chestnut-burr "*Rustroemia*" spp. in Europe has been so thorough. The distinctive thick-walled hairs, tiny biguttulate spores and granularly roughened medullary excipulum preclude assignment to any species presently described in *Lanzia*. On the assumption that spores in this collection may not have been mature enough to reveal pigmentation, accommodation in *Lambertella* was also considered, although no presently recognized species of that genus matches our collection either. Cultural studies are needed to elucidate the relationship of the stromata to the apothecia. It should be sought again in Tenerife.

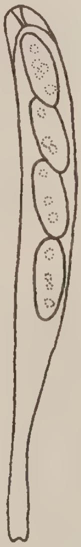
2. **Lanzia sp. 409**

RECENT TAXONOMIC
TREATMENTS: None.

PREVIOUS MACARONESIAN
RECORDS: None.

KNOWN MACARONESIAN
DISTRIBUTION
CANARY ISLANDS.
Tenerife. CUP-MM 409.

SUBSTRATUM: On leaf blade.



Lanzia sp. 409, 4-spored ascus, CUP-MM 409, x 1000.

Notes: APOTHECIA solitary from small stromata, disc reddish-brown, 0.5 mm in diam, darker at margin;

stipe reddish brown, 190 x 150 µm. STROMA a small, black, disc-shaped area on the adaxial leaf surface; rind covering the dorsal stromatal surface only, composed of a single layer of globose cells with outermost cell walls melanized; medulla poorly developed with minimal hyphal invasion of subtending host tissues. ECTAL EXCIPULUM of three layers: the outer layer ca. 6.4 µm wide along flanks, of light brown textura porrecta "turning out" at a high angle to the excipular surface, cells 1.0-1.6 µm broad; middle layer two cells thick of light brown textura prismatica, with cells somewhat inflated, 3.0-5.8 µm broad, oriented parallel to receptacle surface; inner layer 8 µm broad, of light brown textura porrecta, cells 2.7-3.2 µm broad; margin of dark brown-walled and somewhat interwoven textura porrecta; stipe composed of hyaline textura porrecta parallel to the stipe axis, cells 2.7-3.7 µm broad. MEDULLARY EXCIPULUM of loosely interwoven, light brown-walled textura intricata, cells 2-3.5 µm broad. SUBHYMENIUM poorly differentiated. ASCI from repeating croziers, clavate, 60-70 x 3-4 µm, pore channel wall faintly J+, apices thickened (up to 3 µm), 4-spored. ASCOSPORES uniseriate, hyaline, ellipsoid, 2-3-multiguttulate, 8.0-8.5 x 2.2-3.0 µm. PARAPHYSES filiform, septate, sparsely branched, 1 µm broad, not exceeding asci.

In the absence of pigmented ascospores, which may be due to immaturity of this collection, placement in Lambertella is ruled out and this species is provisionally accommodated in Lanzia. While the 4-spored asci and complex excipular structure set this species apart, the collection upon which this description is based is too meagre to constitute a type specimen. Identification of the host and cultural studies also await acquisition of additional material.

MOELLERODISCUS P. Hennings 1902

= Ciboriopsis Dennis 1962

Key to the known Macaronesian species

1. Excipular tissues of apothecia light blue in Melzer's reagent after pretreatment in 10% KOH 2
1'. Excipular tissues not so reacting 3

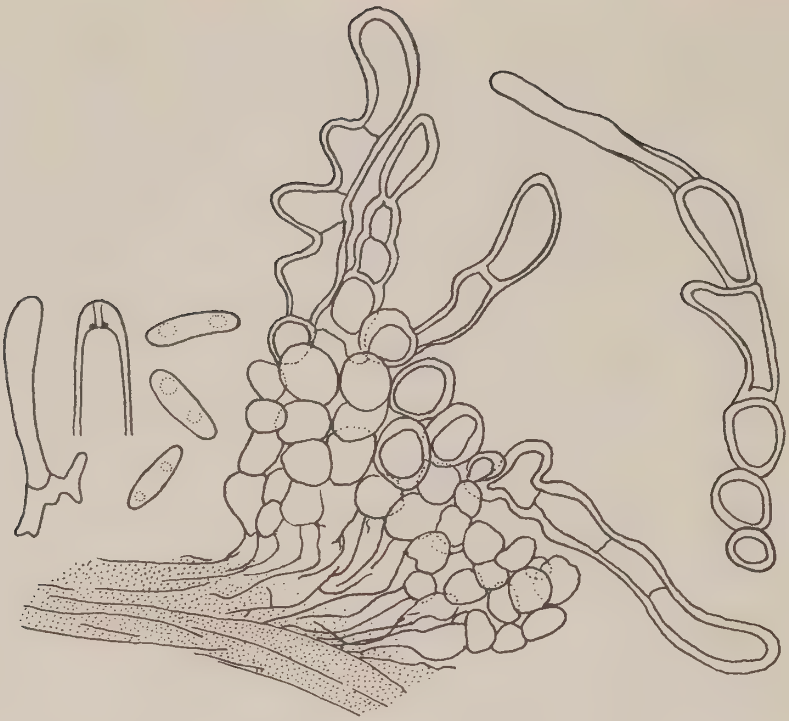
2(1). Ascus epiplasm purple in Melzer's reagent.
1. M. iodotingens subsp. **iodotingens**
2'(1). Ascus epiplasm not so reacting.
2. M. iodotingens subsp. **canariensis**
3(1'). Ascospores 3.7-5.9 (-6.6) x 1.5 µm; apothecia on line stromata on leaves of Hedera helix.
3. M. hederae
3'(1'). Ascospores (5.6-) 6.3-8.1 x 1.4-2.2 µm; apothecia on petioles, midribs, leaf blades, and mummied stone fruits. **4. Moellerodiscus sp. 1881**

1. **Moellerodiscus IODOTINGENS** Kohn & Korf, sp. nov. subsp. IODOTINGENS

RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

Apothecia solitaria vel dispersa, in foliorum laminis, venis, petiolisque putrescentibus stromate infectis; receptaculum cupulatum vel plano-convexum depressionem centralem praebens, 2-3 mm in diam., discus ochraceo-brunneis, in sicco brunneolescens; receptaculi parietes disco pallidius ochraceo-brunnei, furfuracei; stipes 1-2 mm longus, saltem ad basin atrobrunneus. Excipulum ectale 20-60 µ latum, in gelatina inclusum, ex zonis duabus compositum, zona interiore ex textura porrecta ad superficiem receptaculi parallela formata, parietibus tenuibus, cellulis 2-3 µ latis, zona exteriore ex textura globulosa vel angulari pallide brunnea formata in catenis ad superficiem receptaculi parallelis ordinata, cellulis 3-8 µ latis, gelatina in substantia reagente Melzerana coerulescente post usum 10% KOH antecedentum; cellulae extimae pilos moniliformes ad 70 µ longos hyalinos vel parietibus pallide brunneis praeditos, interdum granulari-incrustatos, efferentes, quibus pilis abundantissimis ad marginem ubi fere semper parietibus brunneis praediti sunt; stipitis cellulae ectales ad axin stipitis perpendiculariter extentae, in gelatina inclusae, pilos moniliformes parietibus brunneis praeditos efferentes, cellulis parietibus atrobrunneis praeditis ad basin stipitis repertis. Excipulum medullare in latitudivariabile, ex textura intricata parietibus pallide brunneis praedita ad superficiem receptaculi plus minusve parallela, cellulis 1-2 µ latis, plerumque granulari-incrustatis, cellularum contento in substantia reagente Melzerana purpureo; stipitis excipulum medullare eo receptaculi simile,



M. iodotingens subsp. **iodotingens,** young ascus, with repeating crozier, CUP-MM 2091, x 1000; ascus apex showing blueing of ascus pore channel wall in Melzer's reagent after pretreatment in 10% KOH, 3 ascospores, excipulum near the margin, and a hair from lower on the receptacle, CUP-MM 1880, x 1000.

cellulis 2-3 µ latis exceptis. Asci clavati, ex uncis enati, 8-spori, 50-60 x 5-7 µ, epiplasmate in substantia reagente Melzerana purpureo, apice incrassato (3 µ), pori canalis pariete dilute J+ sine usu KOH antecedente, reactione aucta cum usu 10% KOH antecedente. Ascosporae ellipsoideae, hyalinae, biguttulati, 7-8.8 (-10.2) x 2-3 µ, biseriati, germinatione tubos germinales formantes in conformatione quae "crux coptica" dicitur. Paraphyses subclavatae, 1 µ latae, simplices, septatae, ascos in longitudine non excedentes.

APOTHECIA solitary to scattered on decaying stromatized leaf blades, veins, and petioles; receptacle cupulate to plano-convex with a central depression, 2-3 mm in diam; disc ochraceous brown drying to tan; surface of receptacle paler ochraceous brown than disc, furfuraceous; stipe 1-2 mm long, dark brown at least at base. ECTAL EXCIPULUM 20-60 µm wide, bound in gel, of two zones: the inner zone of thin-walled textura porrecta turning out perpendicularly to the surface of the receptacle, cells 2-3 µm broad; outer zone of pale brown

textura globulosa to textura angularis, oriented in chains perpendicular to the surface of the receptacle, cells 3-8 µm broad, gel turning blue in Melzer's reagent following pretreatment in 10% KOH; outermost cells giving rise to hyaline to light brown-walled moniliform hairs up to 70 µm long, occasionally granularly roughened, most abundant at the margin where hairs are almost always brown-walled; ectal cells of stipe turning out perpendicular to the stipe axis, bound in gel, giving rise to brown-walled moniliform hairs, dark brown-walled cells present at the base of stipe. MEDULLARY EXCIPULUM variable in breadth, of pale brown-walled textura intricata oriented more or less parallel to receptacle surface, cells 1-2 µm broad, usually granularly roughened, cell contents purple in Melzer's reagent; medullary excipulum of the stipe same as that of the receptacle except cells 2-3 µm broad. ASCI clavate, arising from croziers, 8-spored, 50-60 x 5-7 µm, epiplasm purple in Melzer's reagent, apex thickened (up to 3 µm), pore channel wall faintly J+ without KOH pretreatment, reaction enhanced with pretreatment in 10% KOH. ASCOSPORES biseriate, ellipsoid, hyaline, biguttulate, 7.0-8.8 (-10.2) x 2.0-3.0 µm, germinating in a "Coptic cross" configuration much later followed by production of a single germ tube. PARAPHYSES subclavate, 1.0 µm broad, simple, septate, not exceeding asci in length.

HOLOTYPE: R.P. Korf, L.M. Kohn, N. Korf & A.Y. Rossman, on decaying, stromatized leaf blades, veins, and petioles, cultivated garden, Cabo da Praia, Terceira, Azores, Portugal, 8.iv.1978. (CUP-MM 1880) (K, TFC: ISOTYPES.) (ISOTYPES will also be distributed in Korf & Gruff, Discomycetes Exsiccati.)

KNOWN MACARONESIAN DISTRIBUTION

AZORES.

Flores. CUP-MM 2070, 2091, 2146, 2188 (TFC).
São Miguel. CUP-MM 1739.
Terceira. CUP-MM 1880 (holotype, isotypes), 1883, 1923, 2062.

MADEIRA.

Madeira. CUP-MM 2271.

SUBSTRATA: on decaying, stromatized leaf blades, veins and petioles of Myrica faya, ? Pittosporum sp., Hedera helix, etc., and on herbaceous stems.

Notes: The tissues blueing in Melzer's reagent (at least after pretreatment in 10% KOH) and the biguttulate ascospores distinguish this species from M. tenuistipes (Schroet.) Dumont. The larger ascospores and abundant moniliform hairs easily distinguish it from M. musae Dumont. Reactions in Melzer's reagent are particularly striking in this species: with pretreatment in 10% KOH the ectal excipulum consistently turns light to medium blue in Melzer's reagent; without pretreatment cell contents of all tissue zones are purple-brown in that reagent.

The "Coptic cross" spore germination on agar was consistently noted for many of the collections that were cultured, both in this subspecies and in M. iodotingens subsp. canariensis (see photograph under that subspecies). We have no explanation for this elaborate form of germination, usually seen within 24 hours. Only after 48 to 72 hours (at ambient room temperatures in our field hotel/laboratories) does further hyphal development ensue, with usually a single, long germtube observed from any one spore. Except for melanized cells around the base of the stipe, association with stromatized substrata is purely circumstantial, since no stromatic tissue has been produced in our cultures derived from ascospores.

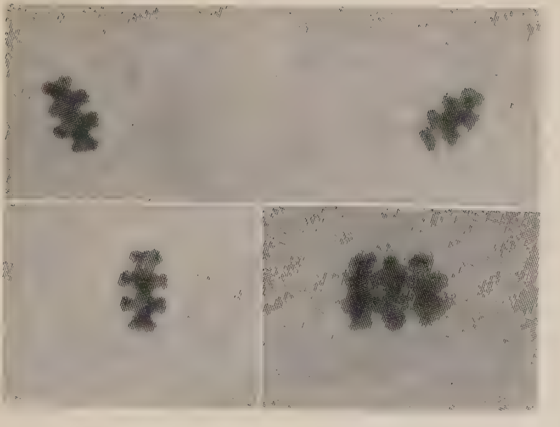
2. **Moellerodiscus iodotingens** Kohn & Korf in Kohn subsp. **CANARIENSIS** Kohn, **subsp. nov.**

RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

Subspeciei typicae fere omni ex parte conveniens, sed apotheciis aurantio-brunneis, excipulo ectali zona interiore carente, et contento cellularum in zonis omnibus receptaculi non purpurascente in substantia reagente Melzerana differt. Huius subspeciei distributio ad Insulas Canarienses limitata.

Agreeing with the description of Moellerodiscus iodotingens subsp. iodotingens in all respects except for the orange-brown color of the apothecia, lack of an inner zone of the ectal excipulum, and lack of a purple reaction in Melzer's reagent of cell contents in all zones of the receptacle. Distribution of the subspecies is confined to the Canary Islands.



M. iodotingens subsp. **canariensis,** 6 ascospores (3 separated, 3 discharged in a group) germinating on water agar in "Coptic cross" configuration 12 hours after being discharged, CUP-MM 1309, x 1000 (photo: R.P. Korf).

HOLOTYPE: R.P. Korf, W.C. Denison, L.M. Kohn & M.A. Sherwood, on leaf blades of Prunus lusitanica L., west of Fuente de las Pulgas, Las Yedras, Monte de las Mercedes, Tenerife, Canary Islands, Spain, 12.i.1976. (CUP-MM 545)

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.
- **La Palma.** CUP-MM 670.
- **Tenerife.** CUP-MM 296, 445, 446, 545 (holotype), 601 (TFC), 607, 608, 1181, 1186, 1309, 1310.

SUBSTRATA: On leaf blades and petioles of Prunus lusitanica L. and of undetermined hosts.

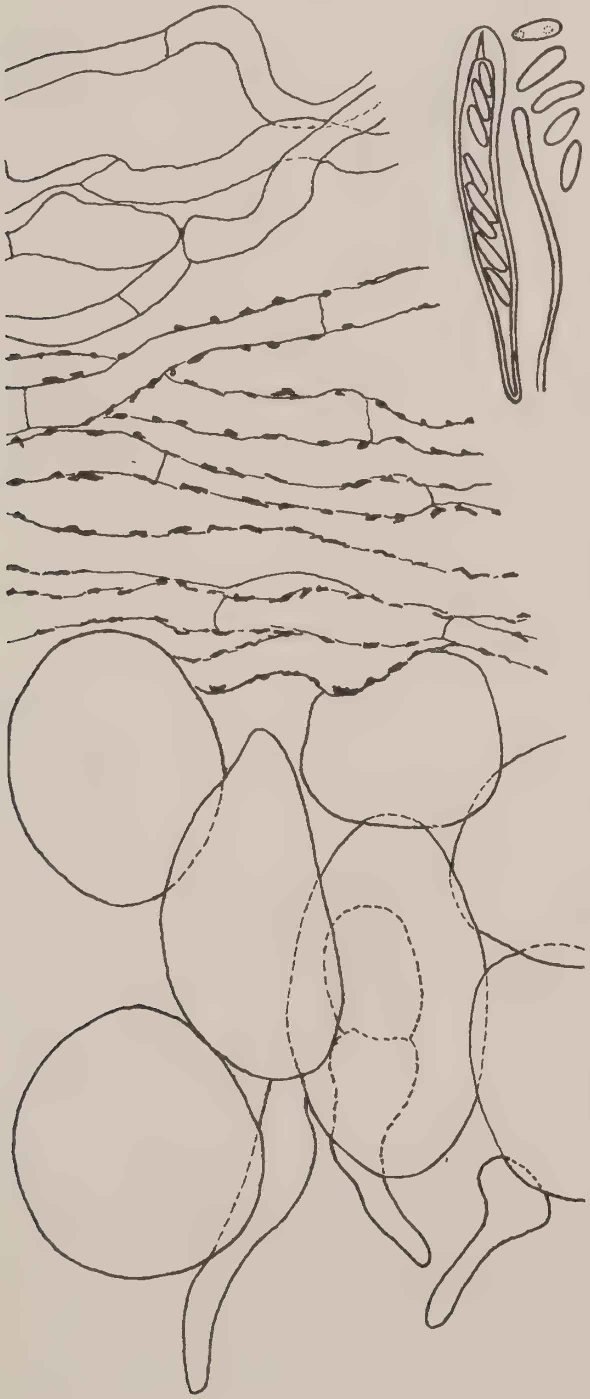
Notes: Our field notes for spore germination in the collection from La Palma indicate germination by a single germ tube in 24 hours. All other collections for which spore germination was observed showed the typical "Coptic cross" germination shown in the photograph above, just as in the typical subspecies. It is certainly possible that we overlooked "Coptic cross" germination in the La Palma collection, but normal germ tubes are not recorded by us for other collections until at least 48 to 72 hours after discharge. The possibility of MM-670 representing yet another taxon cannot be ignored.

3. **Moellerodiscus HEDERAE** Korf & Kohn, **sp. nov.**

RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.

Stroma in materia viva stroma-lineare irregulare cum apotheciis associatum; cortes ex cellulis saturatae pigmentosis, aspectu frontali epidermoideis, composita. Apothecia solitaria vel dispersa, in paginis foliorum et adaxialibus et abaxialibus reperta, breviter stipitata; receptaculum patelliforme, 1.25-2 mm in diam.; discus rufus, in sicco brunneolescens; margo integer, elevatus, disco obscurius brunneus; receptaculi parieties in sicco rufi, furfuracei; stipes brevissimus, denigratus. Excipulum ectale zona est 25-50 µ lata, composita ex textura globulosa parietibus tenuibus pallide brunneis praedita, cellulis 10-30 µ in diam.; continuum ad marginem ubi cellularum parietes saturatius pigmentosae sunt, cellulis extimis processus 2-cellulares vel pluricellulares, filiformes vel clavatos, 10-20 µ longos et interdum aggregatos in fasciculos producentibus. Excipulum medullare ex stratis duobus compositum, zone interiore 50-80 µ lata, ex textura intricata laxe intertexta formata, cellularum parietibus pallide brunnea ad superficiem receptaculi parallela formata, cellulis 3-8 µ latis, grosse granulari-incrustatis. Subhymenium zona est mediocriter distincta, ex catenis uncorum iteratorum maxima pro parte composita. Asci cylindrici vel subclavati, ex uncis enati, 8-spori, 36-44 x 2.9 µ, apice incrassati, pori canalis pariete tenuiter J+ non nisi cum usu 10% KOH antecedente. Ascospori hyalini, anguste ellipsoidei, 3.7-5.9



M. hederae, ectal and medullary excipulum, ascus, paraphysis, 5 free ascospores, CUP-MM 2147, x 1000.

(-6.6) x 1.5 μ, oblique uniseriati vel biseriati. Paraphyses comparate paucae, filiformes, septatae, 0.5 μ latae, ascos longitudine non excedentes.

STROMA in fresh material an irregular line stroma associated with apothecia; rind composed of deeply pigmented cells which are epidermoid in face view. APOTHECIA solitary to scattered, occurring on both adaxial and abaxial sides of leaves, short stipitate; receptacle patelliform, 1.25-2.0 mm in diam; disc reddish brown drying to tan; margin entire, elevated, darker brown than disc; sides of receptacle reddish brown when dry, furfuraceous; stipe very short, blackened. ECTAL EXCIPULUM a zone 24.7-50 μm wide, of thin-walled, light brown-walled textura globulosa, cells 10-30 μm in diam, continuing to margin where cell walls are more deeply pigmented; outermost cells giving rise to 2- to several-celled filiform to clavate processes 10-20 μm long and occasionally grouped in fascicles. MEDULLARY EXCIPULUM composed of two layers: the inner zone, 50-80 μm broad, of loosely interwoven textura intricata, cell walls light brown, cells 3-4 μm broad; outer zone, 20-30 μm broad, of light brown textura porrecta oriented parallel to the surface of the receptacle, cells 3-8 μm broad with coarsely granular incrustations. SUBHYMENIUM a poorly differentiated zone composed primarily of chains of repeating croziers. ASCI cylindrical to subclavate, arising from croziers, 8-spored, 36-44 x 2.9 μm, ascus apex thickened, pore channel wall weakly J+ only after pretreatment with 10% KOH. ASCOSPORES obliquely uniseriate or biseriate, hyaline, narrowly ellipsoid, 3.7-5.9 (-6.6) x 1.5 μm. PARAPHYSES relatively few, filiform, septate, 0.5 μm broad, not exceeding asci in length.

HOLOTYPE: R.P. Korf, L.M. Kohn, N. Korf & A.Y. Rossman, on leaves of *Hedera helix*, Lajes das Flores, Flores, Azores, Portugal, 14.iv.1978. (CUP-MM 2147)

KNOWN MACARONESIAN DISTRIBUTION

AZORES.

Flores. CUP-MM 2147 (holotype).

Notes: The narrowly ellipsoid ascospores, lack of a strong ascus pore channel reaction in Melzer's reagent, and association with a line stroma with epidermoid cells in face view set this species apart from previously described species of *Moellerodiscus*. While the granularly roughened textura porrecta just inside the globose cells of the ectal excipulum has been considered by others (Dumont, 1976; Spevak and Korf, 1966) to be an inner layer of the ectal excipulum, in this species the layer appears to be more continuous with the medullary excipulum and is described here as an outer layer of that zone. Further comments on the nature of the stroma await cultural studies from future collections, as unfortunately attempts to culture this material were unsuccessful: no germination was noted in 48 hours, and single, polar germ tubes only one to three times as long as the spore were noted after 7 days, and the cultures failed to grow further. Another species of this genus, M. iodotingens subsp. iodotingens, occurs on leaves of this host under the same conditions (CUP-MM 2091, 2146), but is readily distinguished on field and microscopic characters.

4. **Moellerodiscus sp. 1881**

RECENT TAXONOMIC TREATMENTS: None.

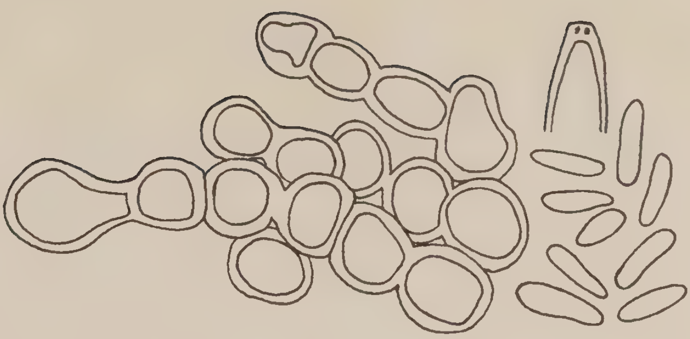
PREVIOUS MACARONESIAN RECORDS: None.

KNOWN MACARONESIAN DISTRIBUTION

AZORES.
Terceira. CUP-MM 1881 (K) (TFC), 1882.

SUBSTRATA: On midribs, petioles, and leaf blades, (CUP-MM 1881) and stone fruit mummies (CUP-MM 1882).

Notes: APOTHECIA stipitate, arising from stromatized petioles, midribes, leaf blades, and mummified fruits; disc shallowly cupulate to plane, hymenium orange-brown when revived, "rosy-vinaceous" to "flesh" (Raynor) when fresh, receptacle somewhat furfuraceous; stipe dark brown, tapering from the base of the receptacle, up to 4 mm long, thin. STROMA "mummioid," of indeterminate blackened patches of host tissue; medulla of narrow (less than 1.0 µm wide) hyaline prosenchyma disrupting host epidermal and cortical tissues (host cells displaced and/or broken down); rind composed of brown-walled textura angularis to textura globulosa, cells 4-10 µm in diam, covering only the dorsal surface of the stroma. ECTAL EXCIPULUM up to 30 µm wide



Moellerodiscus sp. 1881, section through flanks showing globose ectal excipular cells giving rise to tomentum hyphae, ascus apex showing J+ reaction in Melzer's reagent after pretreatment in 10% KOH, 9 ascospores, CUP-MM 1881, x 1000.

along flanks, narrowing to 16 µm at the margin; along flanks composed of hyaline, thin-walled textura globulosa, cells in chains perpendicular to the apothecial surface, cells up to 15 µm in diam, outermost cells giving rise to tomentum hyphae composed of chains of hyaline, globose to clavate cells; margin composed of prosenchyma parallel to the asci, giving rise to tomentum hyphae up to 15 µm long, made up of chains of brick-shaped to inflated, globose cells and terminating with a clavate cell. MEDULLARY EXCIPULUM a loose layer up to 440 µm wide along the flanks, of hyaline, pale brown-walled textura intricata, cells up to 4.0 µm broad; at margin a compact layer of textura porrecta parallel to the asci. SUBHYMENIUM poorly differentiated. ASCI arising from repeating croziers, cylindrical, 55-72 x 4-5 µm, ascus pore channel weakly J+ only after pretreatment with 10% KOH, 8-spored. ASCOSPORES obliquely uniseriate, narrowly ellipsoid, one-celled, hyaline, (5.6-) 6.3-8.1 x 1.4-2.2 µm. PARAPHYSES cylindrical, simple, septate, 1.0 µm wide, not exceeding asci. STIPE: ectal excipulum of light brown-walled textura prismatica, cells somewhat inflated, oriented parallel to the stipe axis, cells up to 6.0 µm broad; outermost cells giving rise to multicellular hairs, up to 45 µm long, with the ends at a high angle to the stipe axis, the apical cell clavate and sometimes umbonate, longer hairs produced at the stipe base with dark brown, granularly encrusted walls; medullary excipulum of hyaline textura intricata more or less parallel to the stipe axis, cells 2-4 µm broad.

Since some apothecia in these collections were associated with mummified fruits, our preliminary generic field identification was Monilinia. Isolates from a culture derived from a mass of ascospores grown on DIFCO Malt Agar, High pH Mycological Agar, Low pH Mycological Agar, and apples yielded no conidial anamorph except for a Myrioconium "microconidial state." Although the stroma is "mummioid" (Whetzel, 1945), the small, narrow ascospores are unlike those produced by species of Monilinia. In the absence of a Monilia anamorph this fungus must be accommodated in Moellerodiscus; its ascospores are unlike those of Ciboria, many species of which occur on fruits. It is unfortunate that the host is known only from fragments of leaf, stem and fruit which could not be identified. Despite the ample material, the lack of a comprehensive monograph of Moellerodiscus and some hesitancy in assigning it to that genus lead me to avoid describing it as a new species at this time.

POCULUM Velenovský 1934 emend. Dumont 1972

Key to the known Macaronesian species

(In cases where no stromatal tissue is apparent, the genus Crocicreas Fr. emend. Carpenter (Leotiaceae) should also be considered.)

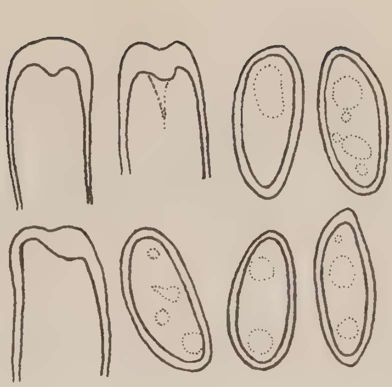
1. Percurrently proliferating, thick-walled dark setae produced from the inner cells of the ectal excipulum .... 4. **Poculum sp. 1385**
1'. No setae present 2

2(1'). Ascus pore channel J-, even after pretreatment in 10% KOH 1. **"Phialea" calopus**
2'(1'). Ascus pore channel J+ 3

3(2'). On cupules of Castanea sativa. 3. **P. sydowianum**
3'(2'). On wood .... 2. **P. firmum**

1. **"Phialea"** cfr. **calopus** (Fr. : Fr.) Quél., Bull. Soc. Bot. France **26**: 234. 1879.

≡ Rutstroemia calopus (Fr. : Fr.) Rehm in Rabenh., Krypt.-Fl. Deutschl., Ed. 2, 1(3) [Lief. 39]: 768. 1893.



"Phialea" cfr. calopus, 3 irregularly thickened ascus apices, 5 ascospores, CUP-MM 1373, x 1000.

RECENT TAXONOMIC TREATMENTS: Carpenter (1981), Dennis (1956), White (1941).

PREVIOUS MACARONESIAN RECORDS: None.

TYPE LOCALITY: Sweden.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.

Gomera. CUP-MM 1373.

SUBSTRATA: On herbaceous stems.

Notes: APOTHECIA solitary to scattered from blackened host tissue; disc up to 2.5 mm in diam, hymenium ochraceous brown, margin darker brown, excipular surface buff; disc narrowing to form a short stipe, 0.25-0.5 mm long, blackened at base. STROMA poorly differentiated although the surface of the host is blackened around the stipe base; hyphae penetrating the host epidermis of dark brown-walled prosenchyma. ECTAL EXCIPULUM up to 52 µm wide, bound in gel, of hyaline textura intricata, cells 1-4 µm broad, giving rise to a "covering layer" 2-4 cells deep of hyaline prosenchyma oriented parallel to the excipular surface; at margin zone narrowing, cells light brown-walled. MEDULLARY EXCIPULUM 315 µm wide at flanks, of hyaline, thin-walled textura intricata; cells 6-11.5 µm wide. SUBHYMENIUM poorly differentiated, possibly bound in gel. ASCI arising from repeating croziers, cylindrical, 85-150 x 8-12.4 µm, ascus pore channel J- even after pretreatment with 10% KOH, apices irregularly thickened (up to 3.2 µm thick), cytoplasm dextrinoid to purplish in Melzer's reagent after pretreatment in 2% KOH, 8-spored. ASCOSPORES biseriate, becoming uniseriate, hyaline, variable, broadly ellipsoid to fusoid-ellipsoid, occasionally flattened on one side, bi- or multiguttulate (but then often with two, prominent, larger guttules), (9.5-)

13.0 (-14.8) x (3.7-) 5.7 (-6.4) µm. PARAPHYSES filiform, 1 µm broad, with a tip 1.5 µm broad, exceeding asci up to 5.3 µm, branched, septate. STIPE: ectal excipulum of two zones: the outer zone a compact "covering layer" 3-5 cells deep of thin-walled, non-gelatinized hyaline to light brown-walled prosenchyma originating from cells of the inner ectal zone, arranged more or less parallel to the stipe axis, with hyphal tips occasionally turning out to form short, septate tomentum hyphae, at base of stipe cells dark brown-walled, embedded in brown, amorphous material; inner layer 50-80 µm wide, originating from medullary cells, of hyaline textura oblita with thick, gelatinous walls; medullary excipulum of hyaline, thin-walled textura intricata, not bound in gel, incorporating many rhomboidal crystals, cells up to 8 µm broad, at point of attachment to host the cells more compact, possibly bound in gel, continuous with hyphae disrupting the host epidermis and penetrating subtending host tissues.

The irregularly thickened ascus apices and J- ascus pore channel walls do not agree with the concept of this species as illustrated by Dennis (1956), and our determination is thus tentative. The taxonomic status of Peziza calopus Fr. : Fr. is still in doubt, and until a monograph of Poculum is completed, no transfer of that epithet to Poculum seems advisable (see also Carpenter, 1981).

2. **Poculum firmum** (Pers. : Fr.) Dumont, Mycologia **68**: 870. 1976.

≡ Rutstroemia firma (Pers. : Fr.) Karst., Bidrag Kännedom Finlands Natur Folk **19**: 108. 1871.

RECENT TAXONOMIC TREATMENTS: Dennis (1956), White (1941).

PREVIOUS MACARONESIAN RECORDS: *Berkeley (1874), †Beltrán Tejera (1980).

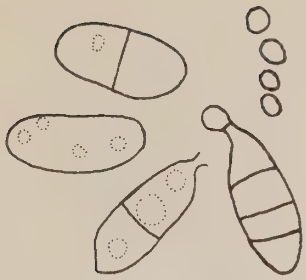
TYPE LOCALITY: Europe.

KNOWN MACARONESIAN DISTRIBUTION

*CANARY ISLANDS.

La Palma. CUP-MM 767, 790, 855 (TFC).

***Tenerife.** *Feb. 1873, on dead wood, 3500 feet (K: specimen lost) n.v.



P. firmum, ascospores at various stages of development, some producing spermatia, CUP-MM 767, x 1000.

SUBSTRATA: On twigs.

Notes: This species, common in Europe, is as yet unknown to us from North America or Asia.

3. **Poculum sydowianum** (Rehm in Sydow) Dumont, Mycologia **68**: 872. 1976.

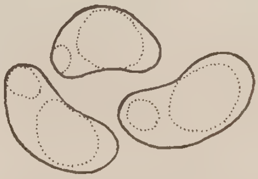
≡ Rutstroemia sydowiana (Rehm in Sydow) White, Lloydia 4: 200. 1941.

RECENT TAXONOMIC TREATMENTS: Dennis (1956), Palmer (1964, 1968), White (1941).

PREVIOUS MACARONESIAN RECORDS: None.

TYPE LOCALITY: Germany.

KNOWN MACARONESIAN DISTRIBUTION
CANARY ISLANDS.
La Palma. CUP-MM 874.



P. sydowianum, ascospores, CUP-MM 874, x 1000

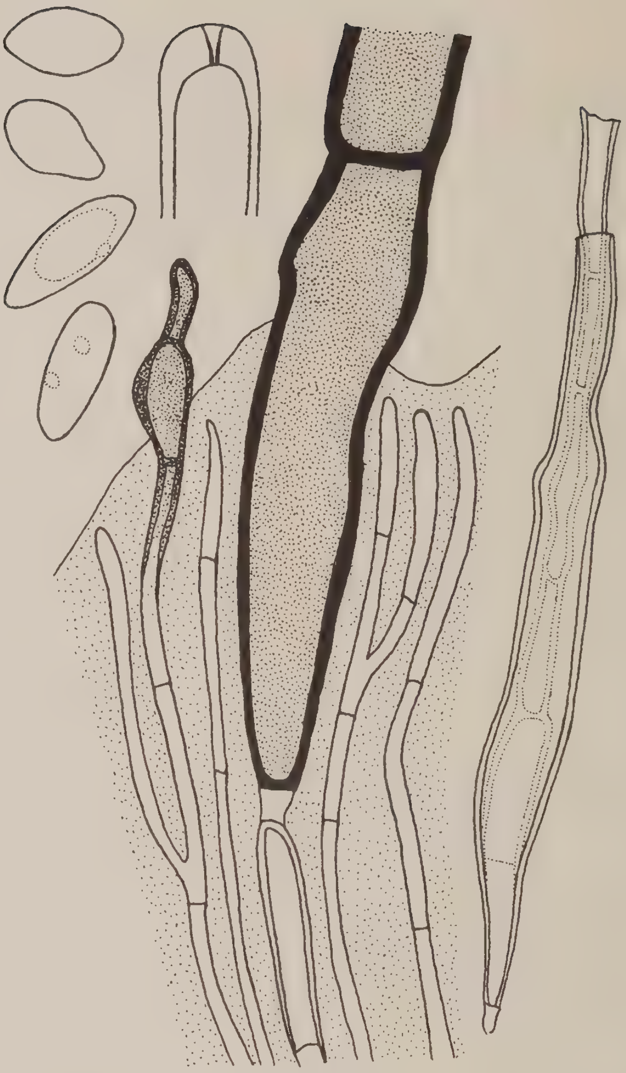
SUBSTRATUM: On cupules of Castanea sativa Mill.

Notes: Castanea burrs should be sought in Macaronesia, since not only this species but three others, all of which would have been referred to Rutstroemia in some treatments [Lanzia echinophila (Bull. : Fr.) Korf, Lanzia sp. 137 (above), and Ciboria americana Durand] are likely to occur wherever chestnut thrives. All four could be confused easily in the field.

4. **Poculum sp. 1385**

RECENT TAXONOMIC TREATMENTS: None.

PREVIOUS MACARONESIAN RECORDS: None.



Poculum sp. 1385, 4 ascospores, ascus apex showing blueing of pore channel wall in Melzer's reagent, section of ectal excipulum with seta in early, 2-celled stage of development, and base of multicellular seta, optical section of base of developing seta showing broken wall of original seta and percurrent proliferation of another seta, also with apex broken off, CUP-MM 1385, spores and ascus apex x 1000, others x 500.

KNOWN MACARONESIAN DISTRIBUTION

CANARY ISLANDS.
Gomera. CUP-MM 1385.

SUBSTRATUM: On dying stem of Rubus sp.

Notes: APOTHECIA solitary to scattered; receptacle deeply cupulate to goblet-shaped, 450 µm in diam; hymenium buff, margin chestnut brown, exterior of receptacle buff, margin and upper part of cup bearing chestnut brown setae; cup narrowing to form a short stipe 150 µm long, buff, clothed with chestnut brown hairs, especially at the base. ECTAL EXCIPULUM composed of two zones: a compact outer zone up to 50 µm wide of hyaline textura oblita to textura intricata with hyphae thin-walled, 2–3 µm broad and immersed in a copious gel, cells at margin brown-walled, giving rise to setae; inner zone up to 30 µm wide of hyaline textura porrecta more or less parallel to receptacle surface, cells up to

5 µm broad; towards margin inner zone merging with the outer zone to form a broad, gelatinized zone at the margin. SETAE originating from inner cells of the outer ectal excipulum, at first 1-3-celled with a clavate apical cell and with thin, light brown walls; walls appearing to thicken and darken as hair proliferates percurrently, ultimately becoming compound (ca. 3 µm thick); mature setae multiseptate, tapering at both ends, 200-500 µm long, up to 20 µm wide at the broadest point, with scars showing internal proliferation. MEDULLARY EXCIPULUM of loosely interwoven, hyaline, thin-walled textura intricata, cells up to 5 µm broad. SUBHYMENIUM up to 50 µm wide, of hyaline, thin-walled textura intricata possibly immersed in gel, cells 1-3 µm broad. ASCI arising from repeating croziers, clavate, 80-105 x 10-13 µm, apex thickened (up to 4 µm), pore channel wall J+, 8-spored. ASCOSPORES uniseriate at first, becoming biseriate, hyaline, ellipsoid to allantoid, usually uniguttulate, occasionally multiguttulate, one-celled, (12-) 15-17 (-18) x 6-7 µm. PARAPHYSES branched, filiform, 1 µm broad, not exceeding asci. STIPE tissues as in apothecium, outer ectal excipular cells giving rise to brown-walled, multiseptate, flexuous hairs ca. 50 µm long. STROMA extremely limited; gelatinized ectal excipular hyphae and non-gelatinized medullary hyphae ramify through host tissues, but are noticably more numerous and compact at the point of stipe emergence from host tissue, where fungal cells and host cuticle are covered by a localized melanized crust.

Unfortunately the collection upon which this description is based contains too few apothecia to constitute a suitable type specimen. While some germination of ascospores on agar was achieved, isolates failed to develop further.

There are perhaps a half dozen or more species that were formerly assigned to Rutstroemia with similar apothecial structure to this species. Drs. K.P. Dumont and R.P. Korf have had a joint project on these species for many years (pers. comm.), of which only one, Rutstroemia setulata (Dearness & House) White, appears to have been described. Other species have been collected in the southern US, in Mexico, in the neotropics and paleotropics. Whether these can be accommodated in Poculum, from which they differ mainly in the presence of setae, or constitute a separate genus has not yet been decided.

SCLEROTINIA Fuckel 1870, typus conservandus

≡ Whetzelinia Korf & Dumont 1972 (homotypic)

One known Macaronesian species

1. **Sclerotinia sclerotiorum** (Lib.) de Bary, Vergl. Morph. Biol. Pilze p. 22. 1884.

≡ Sclerotinia libertiana Fuckel, Jahrb. Nassauischen Vereins Naturk. **23-24:** 331. 1870 (nom. superfl.).

≡ Whetzelinia sclerotiorum (Lib.) Korf & Dumont, Mycologia **64:** 250. 1972.

RECENT TAXONOMIC TREATMENTS: Kohn (1979).

PREVIOUS MACARONESIAN RECORDS: †Bensaude (1926), ††Rosália de Sousa Dias and Lucas (1980).

TYPE LOCALITY: Belgium.

KNOWN MACARONESIAN DISTRIBUTION

†AZORES:
†**São Miguel.** Pereira, n.v.
††MADEIRA.
††**Madeira.** Pedrosa, December 1976, n.v.

SUBSTRATA: On cultivated beet (Bensaude, 1926) and on Salvia splendens Ker-Gawl. (Rosália de Sousa Dias and Lucas, 1980).

Notes: We have not collected this uniquitous pathogen of cultivated plants, but it must surely be widespread in Macaronesia. Neither of the reports in the literature from the region are backed up by specimens.

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STUDIES ON HYPHOMYCETES FROM WEST BENGAL, INDIA, I. CERCOSPORA AND ALLIED GENERA OF WEST BENGAL, 1.

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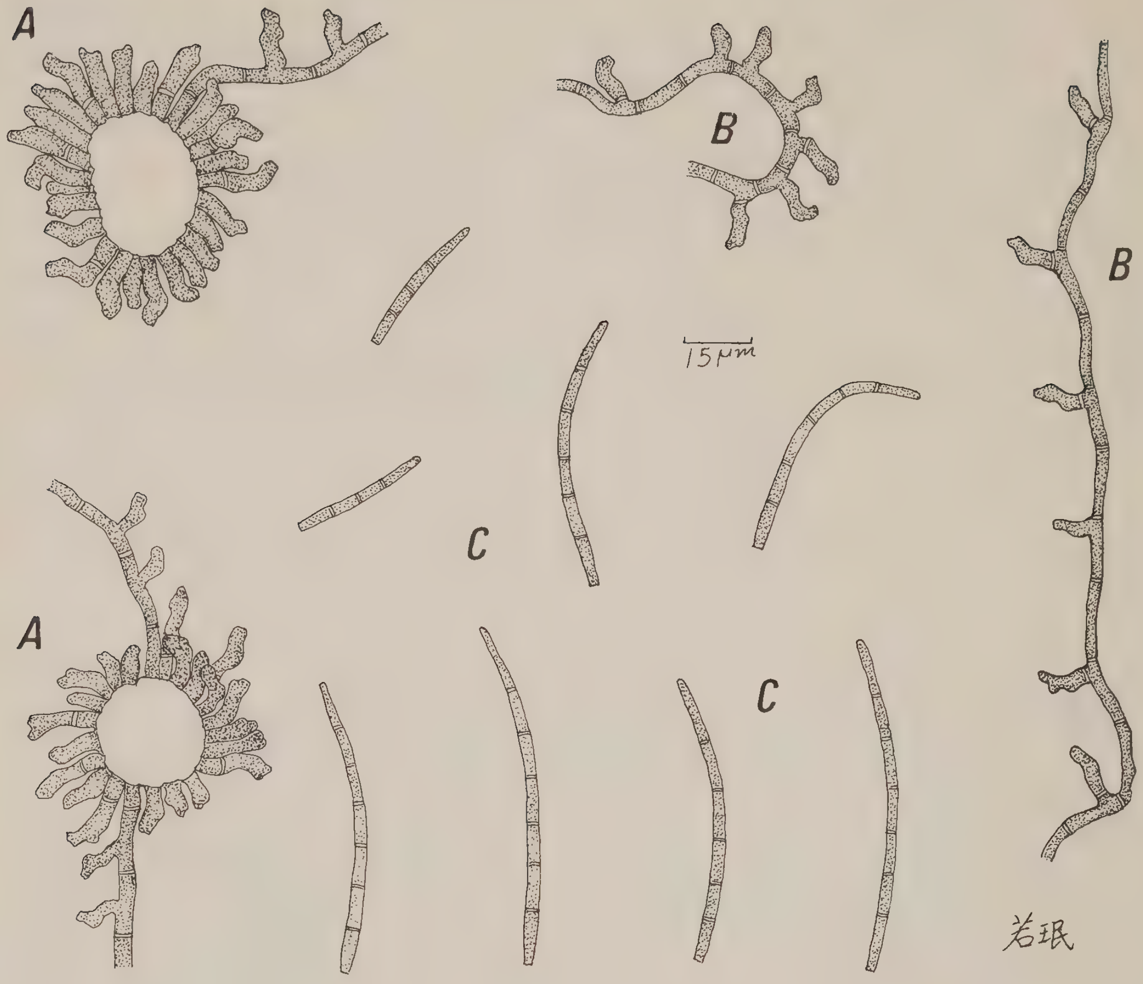
ABSTRACT

This study of 15 species of *Cercospora* and allied genera from West Bengal (India) includes descriptions and illustrations of ten new species and a new combination: *Cercoseptoria vignicola* sp. nov., on *Vigna* sp.; *Phaeoisariopsis argyreiae* sp. nov., on *Argyreia roxburghii*; *Pseudocercospora alternantherae* sp. nov., on *Alternanthera* sp.; *P. euphorbiae-piluliferae* sp. nov., on *Euphorbia pilulifera*; *P. polyalthiae* sp. nov., on *Polyalthia suberosa*; *P. vignigena* sp. nov., on *Vigna* sp.; *P. vitigena* sp. nov, on *Vitis* sp.; *Stenella canthii* sp. nov., on *Canthii dedymi*; *S. dioscoreicola* sp. nov., on *Dioscorea* sp.; *S. stephaniae* sp. nov., on *Stephania hernandifolia*; and *S. myxa* (Sydow *in* Sydow & Mitter) comb. nov., on *Cordia myxa*.

1. *Cercoseptoria vignicola* Yen, Kar & Das, sp. nov. (Fig. 1)

Maculis indistinctis. Caespitulis hypophyllis, invisibilis. Mycelium primarium immersum: hyphis pallidissime olivaceis, septatis, ramosis, 2-3.5μm latis. Stomatibus aliquantum atro-brunneis, globosis 20-40μm diam. Conidiophoris primariis brevis, dense vel valde dense fasciculatis, ex stromatibus oriundis, simplicibus, flexuosis vel undulatis, 0-1 septatis, 0-2 geniculatis, ad apicem irregulariter rotundatis, cicatricibus conidialis indistinctis, 22-75 x 3-5μm. Mycelium secundarium superficiale: hyphis ex stromatibus oriundis, repentis, pallide olivaceis, septatis, ramosis, 2-3μm latis, laevis, conidiophoris secundariis ex hyphis secundariis lateraliter productis, solitariis. Conidiis anguste cylindraceis vel filiformibus, pallidissime brunneo-olivaceis, leniter curvatis, 3-6 septatis, ad apicem rotundatis, basi leniter truncatis, 30-60 x 2.5-3μm.

Habitat in foliis vivis *Vigna* sp. (Leguminosae), ad Raiganj, Dinajpur occidentalis, Bengal occidentalis, India, leg. B. K. Das, 3 XI 1980, No. Pcc4451 (Herb. LAM, Yen #10582), typus.


A
B
B
15 μm
C
A
C
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Leaf spot indistinct. Caespituli hypophyllous, invisible even under the hand lens. Primary mycelium internal: hyphae very pale olivaceous, smooth, septate, branched, 2-3.5µm wide. Stromata well developed, dark brown, globular, 20-40µm in diameter. Conidiophores very short, numerous in a dense or very dense fascicle, simple, flexuous, 0-1 septate, 0-2 geniculate, apex irregularly rounded, conidial scars not visible, 22-75 x 3-5µm. Secondary mycelium superficial: hyphae pale brown-olivaceous smooth, septate, branched, 2-3µm wide, producing laterally the solitary, secondary conidiophores. Conidia narrowly cylindric or filiform, very pale brown-olivaceous slightly curved, 3-6 septate, with a rounded apex and a truncate base, not constricted, 30-60 x 2.5-3µm.

On Vigna sp. (Leguminosae), in Raiganj, West Dinajpur, West Bengal, India. Leg. B. K. Das, 3 November 1980, No. Pcc4451 (Herb. Lam, Yen #10582).

2. Phaeoisariopsis argyreiae Yen, Kar & Das, sp. nov. (Fig. 2)

Maculis primo indistinctis, deinde brunneis et visibilis, orbicularis vel suborbicularis, margine indistinctis, usque 7mm diam., dispersis vel confluentibus. Caespitulis districte hypophyllis, atro-hirsutis. Mycelium primarium immersum: hyphis pallidissime olivaceis, septatis, ramosis, 2-4µm latis. Stromatibus atro-brunneis, irregularis, 40-60µm altis, 25-40µm latis. Conidiophoris districte hypophyllis, pallide brunneo-olivaceis, laevis, 3-25 fasciculatis, synnematiforme aggregatis, multiseptatis, simplicibus, inferne leniter undulatis, superne leniter erectis et separabilis, ad apicem rotundatis, cicatricibus conidialis indistinctis, 60-350 x 4-5.5µm. Conidiis pallide olivaceis, cylindraceis, semper valide curvatis, 1-7 septatis, non constrictis, ad apicem rotundatis basi attenuatis et truncatis, 55-110 x 6-7µm.

Habitat in foliis vivis Argyreia roxburgnii Choisy (Convolvulaceae), ad Raiganj, Dinajpur occidentalis, Bengal occidentalis, India, leg. B. K. Das, 12 X 1980, No. Pcc4492 (Herb. LAM, Yen #10588), typus.

Leaf spot at first indistinct, only some rounded chlorosis area, later becoming brown and visible, orbicular or suborbicular, with an indistinct margin, up to 7mm in diameter, scattered or sometimes confluent. Caespituli strictly hypophyllous, visible under hand lens in dark hairy form. Primary mycelium internal: hyphae very pale olivaceous, septate, branched, 2-4µm wide. Stromata well-developed, dark brown, irregular, 40-60µm high and

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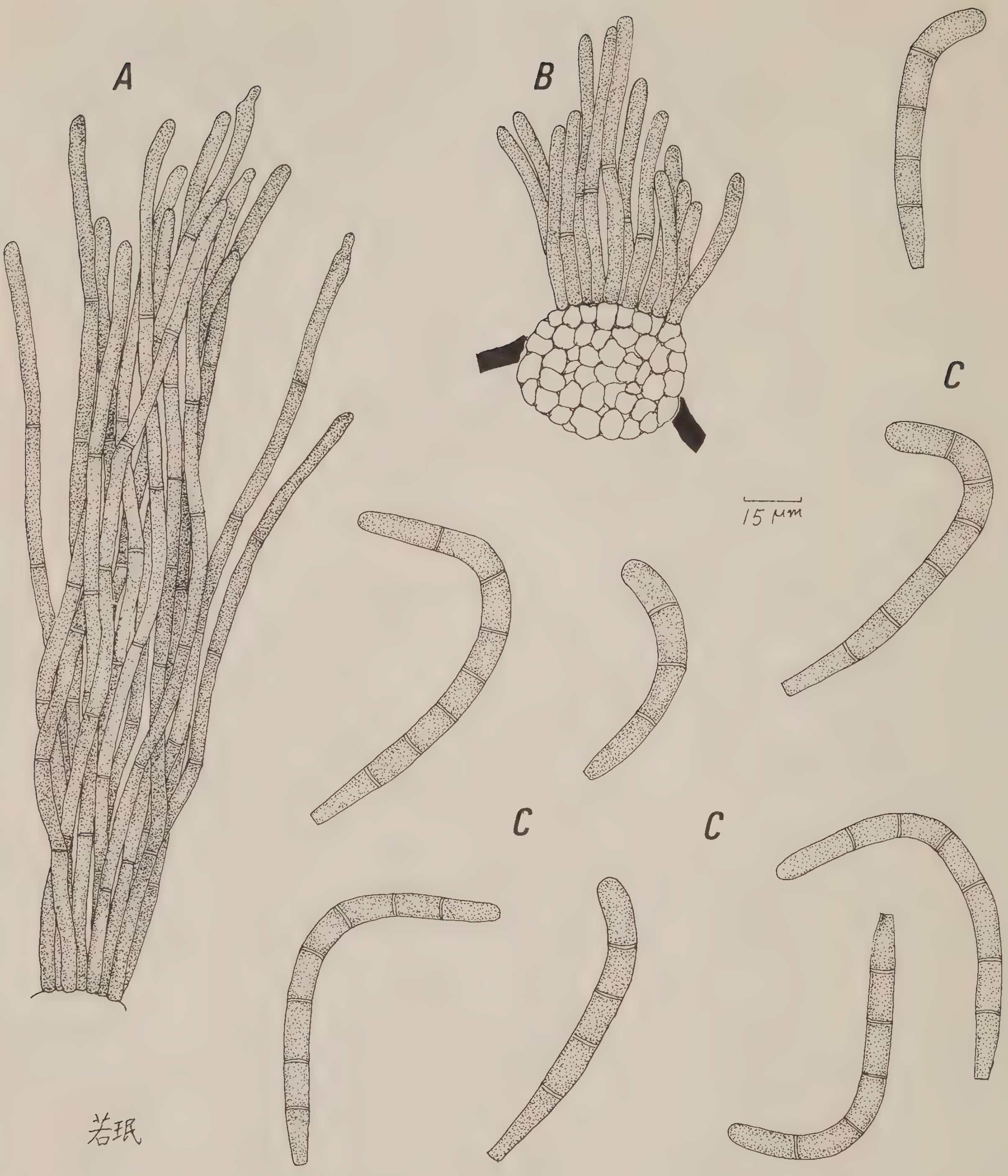
Fig. 1. Cercoseptoria vignicola Yen, Kar & Das: Fascicles of primary conidiophores and formation of external hyphae; B, External hyphae and formation of secondary conidiophores; C, Conidia.


A
B
C
15 μm
C
C
若珉

25-40μm wide. Conidiophores strictly hypophyllous, pale to medium olivaceous, synnematous, 3-25 in loose or dense fascicles, smooth, multiseptate, simple, slightly sinuous below, substraight above, with a rounded apex, conidial cicatrices indistinct, 60-350 x 4-5.5μm. Conidia pale olivaceous, cylindric, always curved, smooth, with a broadly rounded apex, 1-7 septate, not constricted, base attenuate and truncate, 55-110 x 6-7μm.

On Argyreia roxburghii Choisy (Convolvulaceae), in Raiganj, West Dinajpur, West Bengal, India. Leg. B. K. Das, 12 October 1980, No. Pcc4492 (Herb. LAM, Yen #10588).

3. Pseudocercospora alternantherae Yen, Kar & Das, sp. nov. (Fig. 3)

Maculis amphiphyllis, ovoideis vel fusiformis, griseo-brunneis, margine aliquantum indistinctis, saepe dispersis vel confluentibus, 3-12mm longis, 2-4mm latis. Caespitulis amphigenis, autem plerumque hypophyllis, invisibilis. Mycelium primarium immersum: hyphis olivaceo-brunneis, septatis, ramosis 2-5μm latis. Stromatibus brunneis vel atro-brunneis, globosis 20-40μm diam. Conidiophoris primariis amphiphyllis, autem in hypophyllo plus abundis, 5-58 in fasciculo per stomatibus emergentis, pallide burnneo-olivaceis, simplicibus, fere flexuosis, laevis, 0-3 septatis, 0-2 geniculatis, ad apicem rotundatis vel attenuatis, 15-55 x 3-4.5μm. Mycelium secundarium superficiale: hyphis ex stomatibus oriundis vel cum conidiophoris primariis commixa in fasciculo per stomatibus emergentis, pallide brunneo-olivaceis, repentis, septatis, ramosis, 2-3.5μm latis, conidiophoris secundariis lateraliter gerentis. Conidiis obclaviformibus vel obclavato-cylindraceis, pallide brunneo-olivaceis, rectis vel leniter curvatis, laevis, 3-10 septatis, ad apicem rotundatis, basi obconico-attenuatis et truncatis, 32-90 x 2.5-4μm.

Habitat in foliis vivis Alternanthera sp. (Amarathaceae), ad Purulea, Bengal occidentalis, India, leg. B. K. Das, 7 I 1981, No. Pcc4483 (Herb. LAM, Yen #10583), typus.

Leaf spot amphigenous, ovoid or fusiform, brown grayish with an indistinct margin, scattered, but often confluent, 3-12mm long and 2-4mm wide. Caespituli amphiphyllous, but mostly hypophyllous, invisible even under hand lens. Primary mycelium internal: hyphae brown olivaceous, septate, branched, 2-5μm wide. Stromata brown or dark brown, globular, 20-40μm in diameter. Primary conidiophores amphigenous, but more abundant on the lower surface, 5-58 in fascicles emerging through the stomata, pale brown olivaceous, simple, generally flexuous, smooth, 0-3 septate, 0-2 geniculate, apex rounded or attenuate and shouldered,

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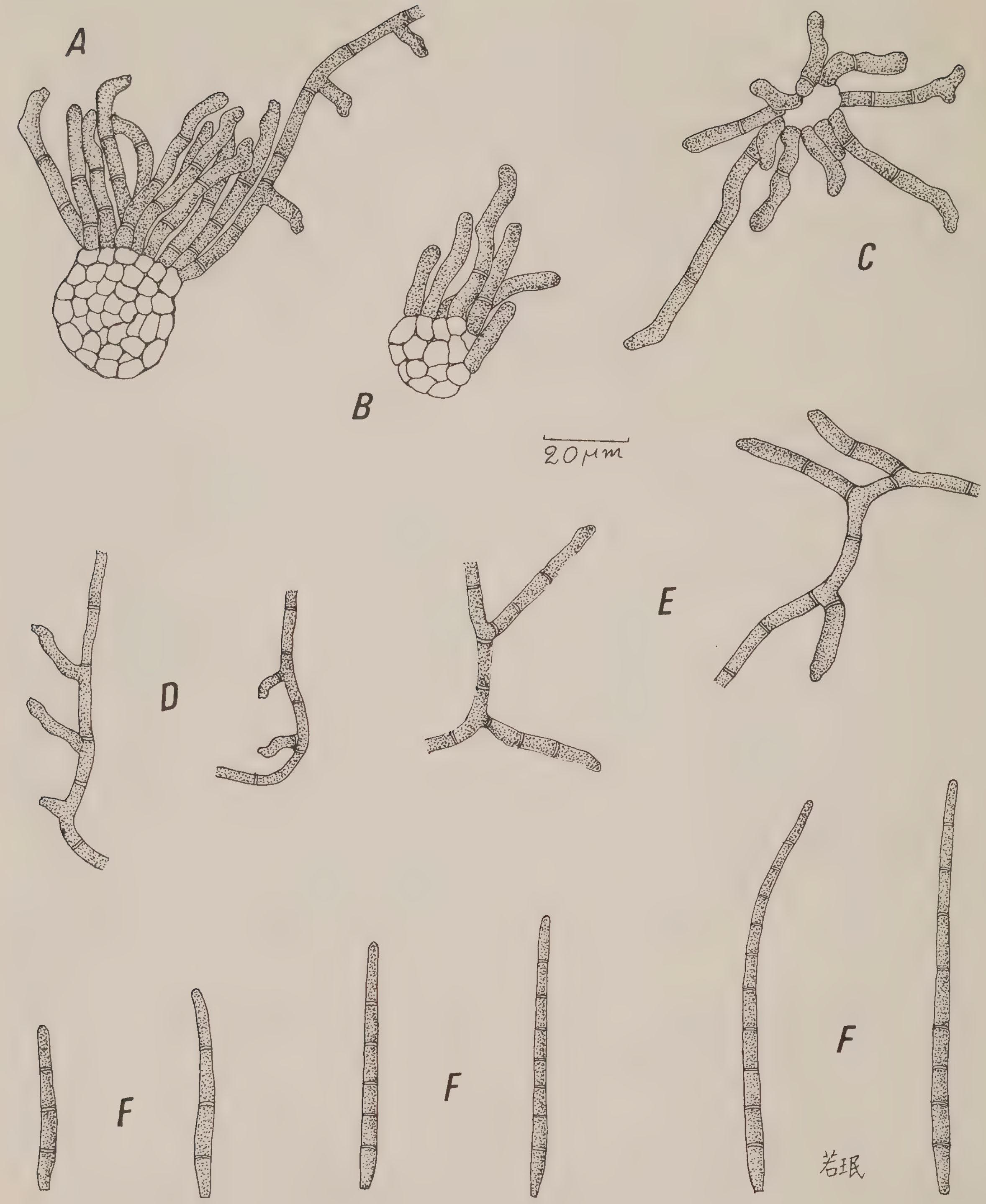
Fig. 2. Phaeoisariopsis argyreiae Yen, Kar & Das: A, Fascicles of old conidiophores; B, Stromata and young conidiophores; C, Conidia.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15-55 x 3-4.5µm. Secondary mycelium external: hyphae arising from the stomata or from a stromata and mixed with the primary conidiophores in a regular fascicle, pale brown olivaceous, repent, septate, branched, 2-3.5µm wide, bearing the secondary conidiophores as lateral branches which are similar to the primary conidiophores. Conidia obclaviform or obclavato-cylindric, pale brown olivaceous, straight or slightly curved, smooth, 3-10 septate, apex rounded, base obconic-attenuate and truncate, 32-90 x 2.5-4µm.

On *Alternanthera* sp. (Amaranthaceae), in Purulea, West Bengal, India. Leg. B. K. Das, 7 January 1981, No Pcc4483 (Herb. LAM, Yen #10583).

Note: The *Pseudocercospora alternanthericola* (Pavgi & U. P. Singh) Deighton differs from this fungus by its mostly epiphyllous fruiting and thicker conidia (2.4-6.3µm compared with 2.5-4µm). On the other hand, the *Cercospora alternantherae-nodiflorae* Sawada differs from this species by its leaf spot indistinct or none.

4. *Pseudocercospora daturina* (Yen) Deighton. CMI Mycol. Pap. 140: 143, 1976.
   =*Cercospora daturina* Yen. Rev. de Mycol. 30: 171, 1965.

Leaf spot indistinct, sometimes as chlorosis area without definite margin. Caespituli amphiphyllous, grayish, effuse. Primary mycelium internal: hyphae almost colorless, septate, branched, 1.5-2.5µm wide. Stromata absent. Primary conidiophores amphiphyllous, 12-40 in fascicles, simple when young, but generally branched when old, pale brown olivaceous, flexuous, 1-4 (rarely 5-6) septate, 1-3 geniculate, sometimes with constrictions at the septum, apex attenuate and decorated with a conidial cicatrice (1.5µm in diameter), 30-70 x 3.5-6µm (Yen: 30-80 x 4-6µm). Secondary mycelium superficial: hyphae arising from the stromata, pale olivaceous, repent, septate, branched, 2-3.5µm wide, bearing the solitary secondary conidiophores as lateral branches. Conidia obclavate-cylindric, pale brown olivaceous, straight or slightly curved, sometimes slightly sinuous, 3-10 septate, apex subconic, base attenuate-truncate, 50-117 x 3.5-5µm (Yen: 51-123 x 3.5-5µm).

On *Datura atramonium* L. (Solanaceae), in Baluhati, Hocorah, West Bengal, India. Leg. B. K. Das, 22 August 1980, No. Pcc4323 (Herb. LAM, Yen #10579).

Distribution: India and Singapore

Fig. 3. *Pseudocercospora alternantherae* Yen, Kar & Das: A, Fascicle of conidiophores and formation of external hyphae; B, Young conidiophores; C, Old conidiophores, D & E, Formation of secondary conidia; F, Conidia. 5.

5. Pseudocercospora euphorbiae-piluliferae Yen, Kar & Das sp. nov. (Fig. 4, A-D)

Maculis hypophyllis, minusculis, obscure brunneis, margine indistinctis, usque 2mm diam. in epiphyllo visibilis, in hypophyllo indistinctis. Caespitulis hypophyllis, raro amphiphyllis, non aspectabilis. Mycelium primarium immersum: hyphis subhyalinis, septatis, ramosis, 2-3.5μm latis. Stromatibus nullis. Conidiophoris plerumque hypophyllis, pallide brunneo-olivaceis, 2-5 in fasciculo per stomatibus emergentis, simplicibus vel ramosis, laevis, erectis vel leniter flexuosis, aliquandum undulatis, 0-6 septatis, non geniculatis, cicatricibus conidialis indistinctis, ad apicem rotundatis, 15-80 x 3.5-5μm. Conidiis obclaviformibus vel obclavato-cylindraceis, pallide brunneo-olivaceis, rectis vel leniter curvatis, 3-5 septatis, non constrictis, ad apicem rotundatis, basi truncatis, 38-74 x 3-5μm.

Habitat in foliis vivis Euphorbiae piluliferae L. (Euphorbiaceae), ad Mashlandapur, Nadia, Bengal occidentalis, India. Leg. B. K. Das, 13 VIII 1980. No. Pcc4305 (Herb. LAM, Yen #10584), typus.

Leaf spot small, brown with an indistinct margin, visible on upper surface, but invisible on lower surface, up to 2mm in diameter. Caespituli mostly hypophyllous, rarely amphiphyllous, invisible. Primary mycelium internal: hyphae almost colorless, septate, branched, 2-3.5μm wide. Stromata absent. Conidiophores generally hypophyllous, 2-5 in fascicles emerging through a stomata, pale brown olivaceous, simple or branched, smooth, with a slightly undulated membrane, straight or slightly flexuous, 0-6 septate, not geniculate, conidial scars indistinct, apex rounded, 15-80 x 3.5-5μm. Conidia obclavate or obclavate-cylindric, pale brown olivaceous, straight or slightly curved, 3-5 septate, not constricted, apex rounded, base truncate, 38-74 x 3-5μm.

On Euphorbia pilulifera L. (Euphorbiaceae), in Mashlandapur, Nadia, West Bengal, India. Leg. B. K Das, 13 August 1980, No Pcc4305 (Herb. LAM, Yen #10584).

Note: This fungus differs from others (Cercospora petila Thir. & Chupp, C. euphorbiae-pubescentis Unam. and C. euphorbiaecola Tharp.) on Euphorbia, by its small brown leaf spots, hypogenous caespituli, poor fascicles and absence of stromata.

6. Pseudocercospora pantoleuca (Saccardo) Deighton CMI Mycol. Pap. 140:53, 1976. (Fig. 5)
=Cercospora pantoleuca Saccardo, nom. nov. (as 'Syd. & Sacc.') in Saccardo & Trotter, Syll. Fung. 25:906, 1931.
=Cercospora pantoleuca H. Sydow & P. Sydow, Philipp. J. Sci. Sec. C (Bot.) 8:284, 1913.
NON Cercospora pantoleuca Saccardo, Michellia 1:268, 1879.

Leaf spot distinct, amphiphyllous, at first small (1-3mm in diam.), vein-limited, green brownish, soon becoming grayish-white in the center with a linear, slightly raised brown-purplish margin, often 3-5 confluent in large blotches, up to 5mm in diameter. Caespituli generally hypophyllous, sometimes slightly amphigenous, dark punctiform. Mycelium internal: hyphae very pale olivaceous, septate, branched, 2.5-4μm wide. Stromata not well-developed, dark brown, irregularly globular, 10-25μm in diameter. Conidiophores chiefly hypogenous, 5-15 in fascicles emerging through the stomata, pale brown olivaceous, simple, sometimes branched, flexuous or sinuous, 1-6 septate, 0-2 geniculate, not continuous, sometimes slightly constricted, apex rounded or attenuate and shouldered, conidial cicatrices indistinct, 25-55 x 3.5-4μm. Conidia obclavate-cylindric, straight or slightly curved, 3-11 septate, pale olivaceous, apex rounded, base obconic-truncate.

On *Clitoria ternatea* (Leguminosae), in Palpara, Nadia, West Bengal, India. Leg. B. K. Das, 25 August 1980, No Pcc4327 (Herb. LAM, Yen #10581).

Distribution: Philippines and India.

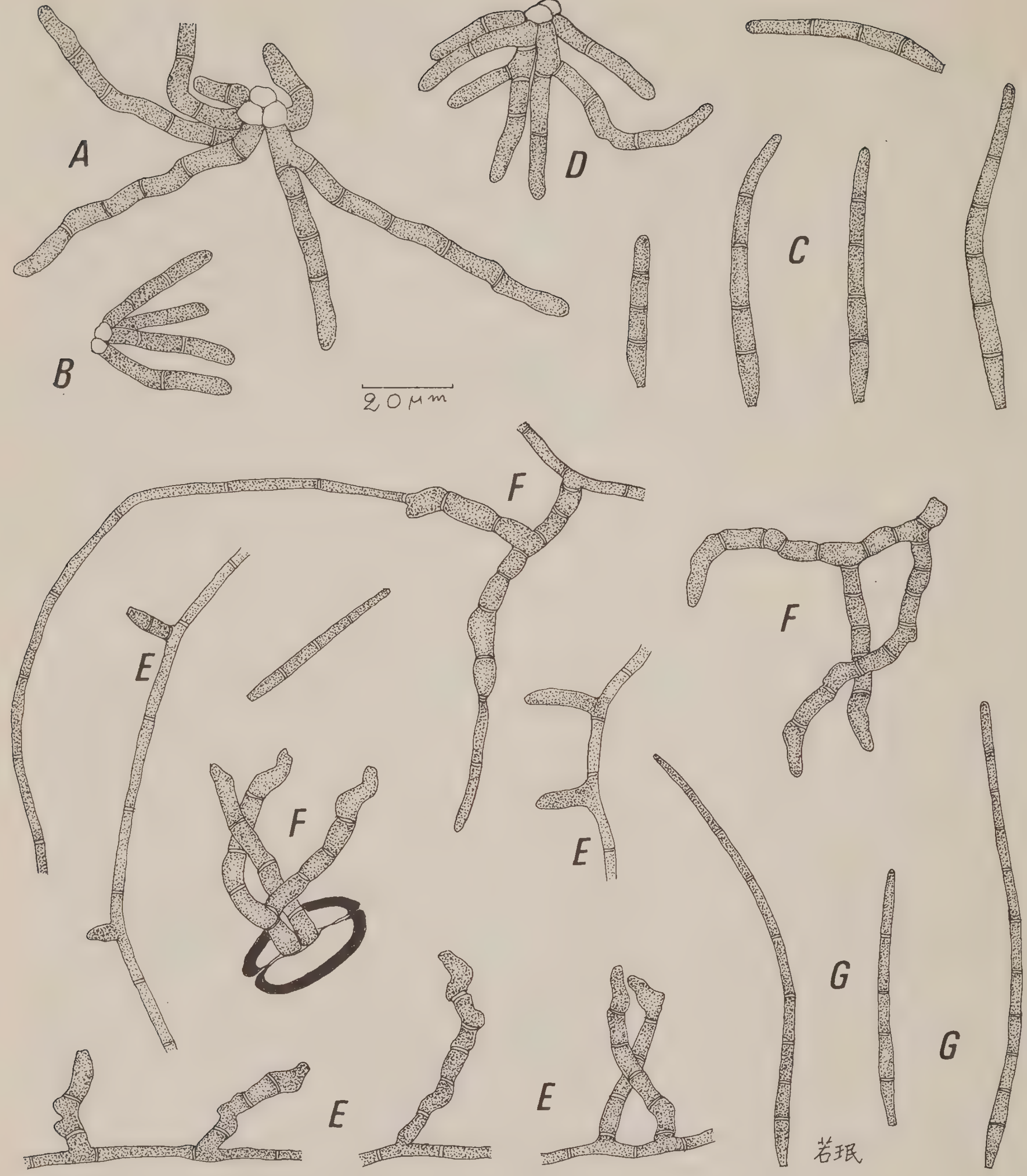
Note: The material of this species from West Bengal (India) differs from others from the Philippines by the largely hypophyllous fruiting and the conidiophores not being continuous.

7. *Pseudocercospora polyalthiae* Yen, Kar & Das, sp. nov. (Fig. 4, E-G)

Maculis indistinctis. Caespitulis hypophyllis, invisibilis. Mycelium primarium immersum: hyphis subhyalinis, septatis, ramosis, 1.5-3μm latis. Stromatibus nullis. Conidiophoris solitariis, non fasciculatis, pallide brunneo-olivaceis, sursum pallidioribus, plerumque simplicibus, interdum ramosis, 0-8 septatis, 0-3 geniculatis, apex attenuatis et truncatis, interdum irregulariter rotundatis, cicatricibus conidialis invisibilis, 12-70 x 3.5-5μm. Mycelium secundarium superficiale: hyphis repentis, pallide olivaceis, laevis, septatis ramosis, 1,5-3μm latis, conidiophoris lateraliter manifestibus. Conidiis gracilis, obclavato-cylindraceis, pallide brunneo-olivaceis, rectis vel leniter curvatis, 3-13 septatis, non constrictis, ad apicem rotundatis vel subconicis, basi obconico-truncatis, 40-156 x 2.5-3.5μm.

Habitat in foliis vivis *Polyalthiae suberosa* Benth. & Hooker (Annonaceae), ad Garia, 24-Parganas, Bengal occidentalis, India. Leg. B. K. Das, 15 XII 1979, No. Pcc4095 (Herb. LAM, Yen #10585), typus.

Leaf spot indistinct or none. Caespituli hypophyllous, invisible. Primary mycelium internal: hyphae very pale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olivaceous, septate, branched, 1.5-3μm wide. Stromata absent. Conidiophores solitary, not in fascicles, generally simple, sometimes branched, straight or flexuous, pale brown olivaceous, paler towards the tip, 0-8 septate, 0-3 geniculate, apex attenuate and shouldered, conidial scars not distinct, 12-70 x 3.5-5μm. Conidia narrowly oblclavate-cylindric, pale brown olivaceous, straight or slightly curved, 3-13 septate, not constricted, apex rounded or subconical, base obconic-truncate, 40-156 x 2.5-3.5μm.

On *Polyalthia suberosa* Benth. & Hooker (Annonacae), in Garia, 24-Parganas, West Bengal, India. Leg. B. K. Das, 15 December 1979, No Pcc4095 (Herb. LAM, Yen #10585).

8. *Pseudocercospora timorensis* (Cooke) Deighton CMI Mycol. Pap. 140:154, 1976.
   =*Cercospora timorensis* Cooke Grevillea 12:38, 1883.

On *Ipomoea batatas* Lamx. (Convolvulaceae), in Samali, 24-Parganas, West Bengal, India. Leg. B. K. Das, 2 September 1980, No Pcc4345 (Herb. LAM, Yen #10580).

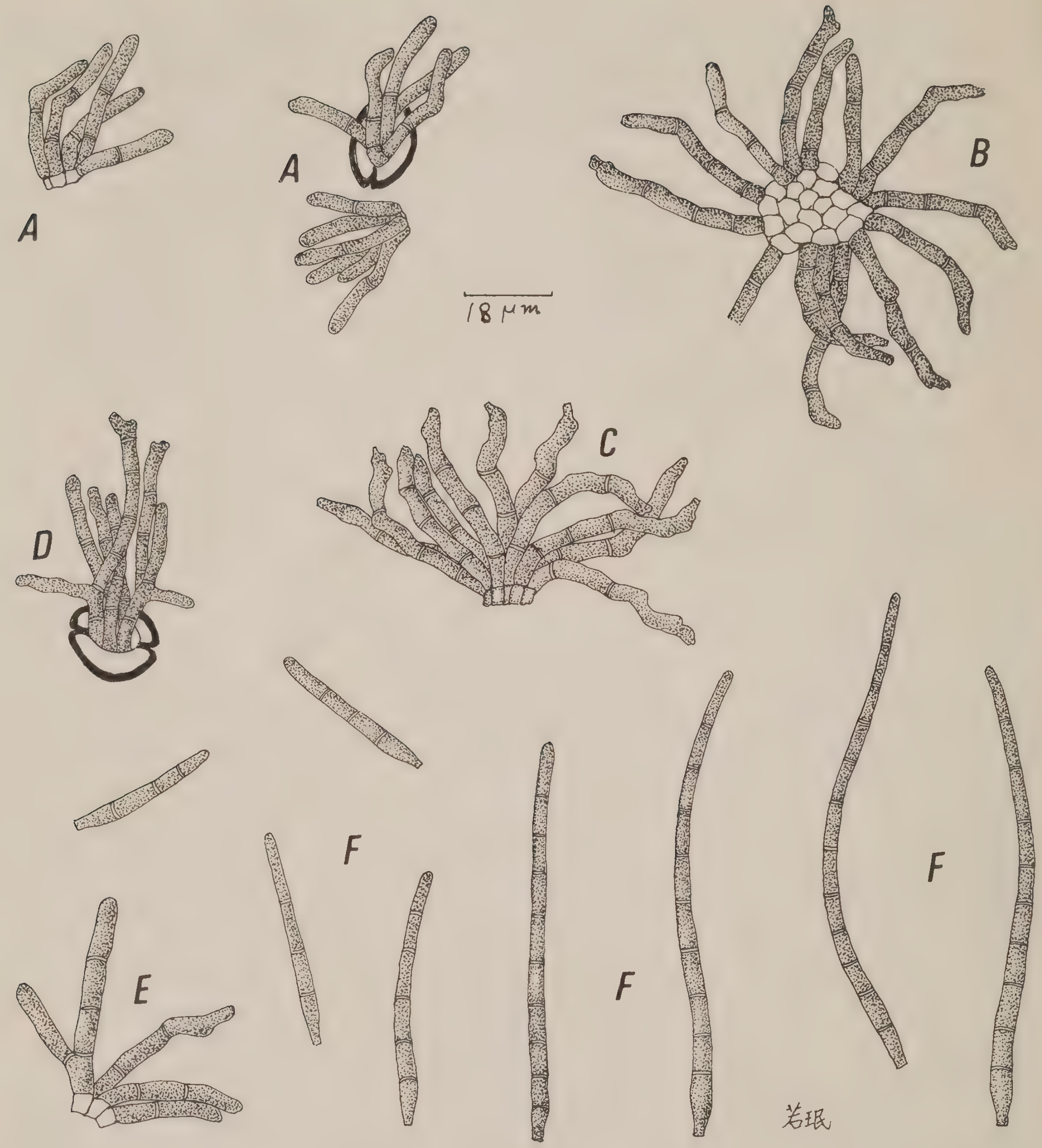
Distribution: Africa, China, Ecuador, India, Japan, Panama, Philippines, and Singapore.

9. *Pseudocercospora trematis-orientalis* (Sun) Deighton CMI Mycol. Pap. 140:155, 1976.
   =*Cercospora trematis-orientalis* Sun J. Agric. (Formosa) Taiwan Prov. Coll. 9:48 (reprint), 1955.

Leaf spot distinct, at first small, brown, irregularly circular, isolate, 0.5-1mm in diameter, soon extending into large lesions, irregularly angular, vein-limited, gray-white in the center, having a brown-purple border with indefinite margin, more distinct on lower surface, scattered, up to 3mm in diameter. Caespituli amphiphyllous, but chiefly epiphyllous, dark punctiform on the upper surface. Mycelium internal: hyphae very pale olivaceous, septate, branched, 2-4μm wide. Stromata dark brown, globular, 20-40μm in diameter. Conidiophores 5-28 in fascicles emerging through the stomata, pale brown-olivaceous, paler towards the tip, straight or slightly flexuous, simple, not branched, smooth, 1-3 septate, 0-2 geniculate, apex rounded or attenuate, conidial scars sometimes distinct, 40-95 x 3.5-4μm. Conidia pale brown-olivaceous, obclavate-cylindric, often slightly curved, or slightly undulated, 3-8 septate, apex rounded or subconical, base obconic-truncate, 40-108 x 3.5-4μm.

On *Trema orientalis* Bl. (Urticaceae), in Raiganj, West Dinajpur, West Bengal, India. leg. B. K. Das, 20 October 1980, No. Pcc4447 (Herb. Lam, Yen #10575).

Fig. 4. A-D, *Pseudocercospora euphorbiae-piluliferae* Yen, Kar, & Das: A & D, Fascicles of conidiophores; B, Young conidiophores; C, Conidia. E-G, *P. polyalthiae* Yen, Kar & Das: E, External hyphae and formation of secondary conidiophores; F, Branched conidiophores; G, Conidia.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Distribution: Taiwan (China) and West Bengal (India).

Note: Sun proposed a common name, "white stars disease on leaves of Trema", which is apropos because of the symptomatic isolated white angular leaf spots which characterize the infected leaves.

10. Pseudocercospora vignigena Yen, Kar & Das, sp. nov. (Fig. 6)

Maculis distinctis, orbicularis vel irregulariter orbicularis, clare brunneis, margine atro-brunneis, dispersis, non confluentibus, 2-5mm diam. Caespitulis amphiphyllis, nigrostrigosis. Mycelium primarium immersum: hyphis fere incoloris, septatis, ramosis, 2-3.5μm latis. Stromatibus mediocoriter evolutis, atro-brunneis, globosis vel irregulariter globosis, 15-40μm diam. Conidiophoris primariis usque 60 in fasciculo per stomatibus emergentis, pallide brunneo-olivaceis, laevis, erectis vel leniter flexuosis, 1-3 septatis, 0-2 geniculatis, apex attenuatis et cubitis, cicatricibus conidialis distinctis, 22-75 x 3-5μm. Mycelium secundarium superficiale: hyphis ex cellulis basalibus conidiophorum primariorum aliquorum oriundis, repentis, pallide olivaceis, septatis, ramosis, 2.5-4μm latis, conidiophoris secundariis erectis lateraliter gerentis. Conidiis cylindraceis, interdum obclavato-cylindraceis, pallide olivaceis, rectis vel leniter curvatis, 3-6 septatis, apice rotundatis, basi attenuatis et truncatis, 33-60 x 4-5.5(-6)μm.

Habitat in foliis vivis Vigna sp. (Leguminosae), ad Raiganj, Dinajpur occidentalis, Bengal occidentalis, India. Leg. B. K. Das, 3 XI 1980, No. Pcc4451 (Herb. LAM, Yen #10582), typus.

Leaf spot distinct, orbicular or irregularly orbicular, bright brown with a dark brown margin, scattered, more visible on the upper surface, 2-5mm in diameter. Caespituli amphiphyllous, visible under hand lens as short black hairs. Primary mycelium internal: hyphae almost colorless, septate, branched 2-3.5μm wide. Stromata not well developed, dark brown, globular or irregularly globular, 15-40μm in diameter. Primary conidiophores up to 60 in dense fascicles emerging through a stromata, pale brown-olivaceous, smooth, simple, straight or slightly flexuous, 1-3 septate, 0-2 geniculate, apex attenuate or shouldered, conidial scars distinct, 22-75 x 3-5μm. Secondary mycelium superficial: hyphae arising from the base of some of the primary conidiophores, repent or lax arcuate, pale olivaceous, septate, branched, 2.5-4μm wide, bearing secondary conidiophores as erect lateral branches. Conidia generally cylindric, sometimes obclavate-cylindric, pale olivaceous, straight or slightly curved, 3-6 septate

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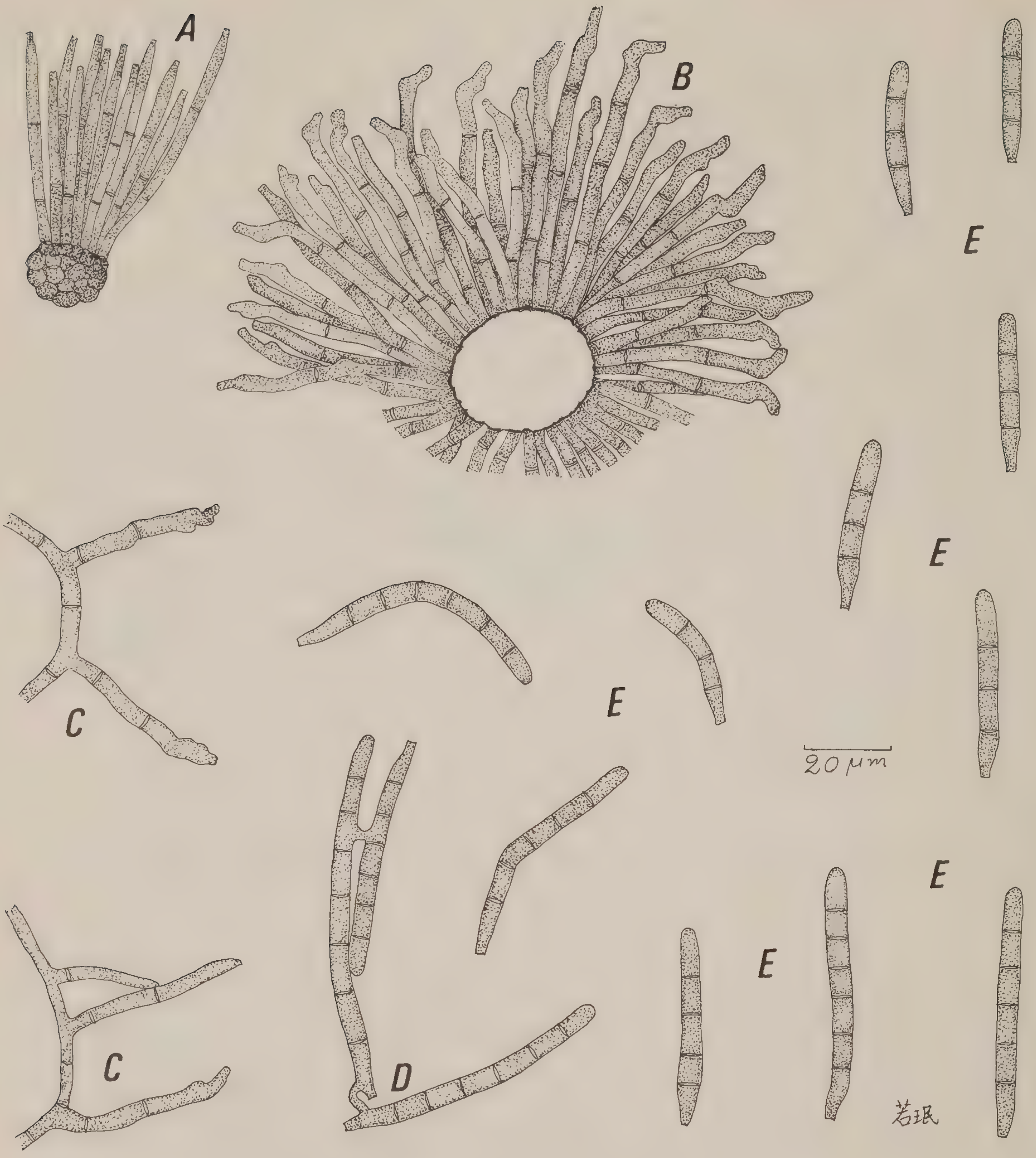
Fig. 5. Pseudocercospora pantoleuca (Saccaardo) Deighton: A, Fascicles of young conidiophores; B & C, Fascicles of old conidiophores; D, Branched conidiophores; F, Conidia.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apex rounded, base attenuate-truncate, 33-60 x 4-5.5(-6)μm.

On Vigna sp. (Leguminosae), in Raiganj, West Dinajpur, West Bengal, India. Leg. B. K. Das, 3 November 1980, No Pcc4451 (Herb. LAM, Yen #10582).

Note: This fungus differs from others (Pseudocercospora cruenta (Saccardo) Deighton, P. dolichi (Ellis and Everhart) Yen, P. mungo Deighton, and P. vignae-reticulatae Deighton) on Vigna by its distinct leaf spots with definite margin and very dense fascicles with up to 60 conidiophores.

11. Pseudocercospora vitigena Yen, Kar & Das, sp. nov. (Fig. 7, A-E)

Maculis indistinctis. Caespitulis amphiphyllis, autem principaliter hypophyllis, invisibilis. Mycelium primarium immersum: hyphis subhyalinis, septatis ramosis, 1.5-2.5μm latis. Stromatibus atro-brunneis, globosis vel irregulariter globosis, 10-30μm diam. Conidiophoris primariis numerosis vel paucis in fasciculo per stomatibus emergentis, pallide olivaceis, eretis vel leniter flexuosis, simplicibus vel ramosis, laevis, continuis vel 1-2 septatis, non geniculatis, apice rotundatis vel irregulariter rotundatis, 10-30 x 2-3μm. Mycelium secundarium superficiale: hyphis ex stromatibus oriundis, pallidissime olivaceis, repentis vel arcuatis, laevis, septatis, conidiophoris secundariis lateraliter gerentis. Conidiis pallide olivaceis, obclavato-cylindraceis, rectis vel leniter curvatis, laevis, non constrictis, 3-11 septatis, ad apicem rotundatis vel subrotundatis, basi obconico-truncatis, 36-82 x 2.5-3.5μm.

Habitat in foliis vivis Vitis sp. (Vitidaceae), ad Sylva Hemtabad, Dinajpur occidentalis, Bengal occidentalis, India. Leg. B. K. Das, 10 X 1980, No. Pcc4418 (Herb. LAM, Yen #10577), typus.

Leaf spot indistinct or none. Caespituli amphigenous, but chiefly hypophyllous, not visible even under hand lens. Primary mycelium internal: hyphae very pale olivaceous, septate, branched, 1.5-2.5μm wide. Stromata slightly developed, dark brown, globular or irregularly globular, 10-30μm in diameter. Primary conidiophores emerging through the stomata, very numerous in each of the larger fascicles, but few in smaller fascicles, pale olivaceous, straight or slightly flexuous, simple or branched, smooth, continuous or 1-2 septate, not geniculate, apex rounded or irregularly rounded, 10-30 x 2-3μm. Secondary mycelium external: hyphae arising from the stomata, sometimes from stromata,

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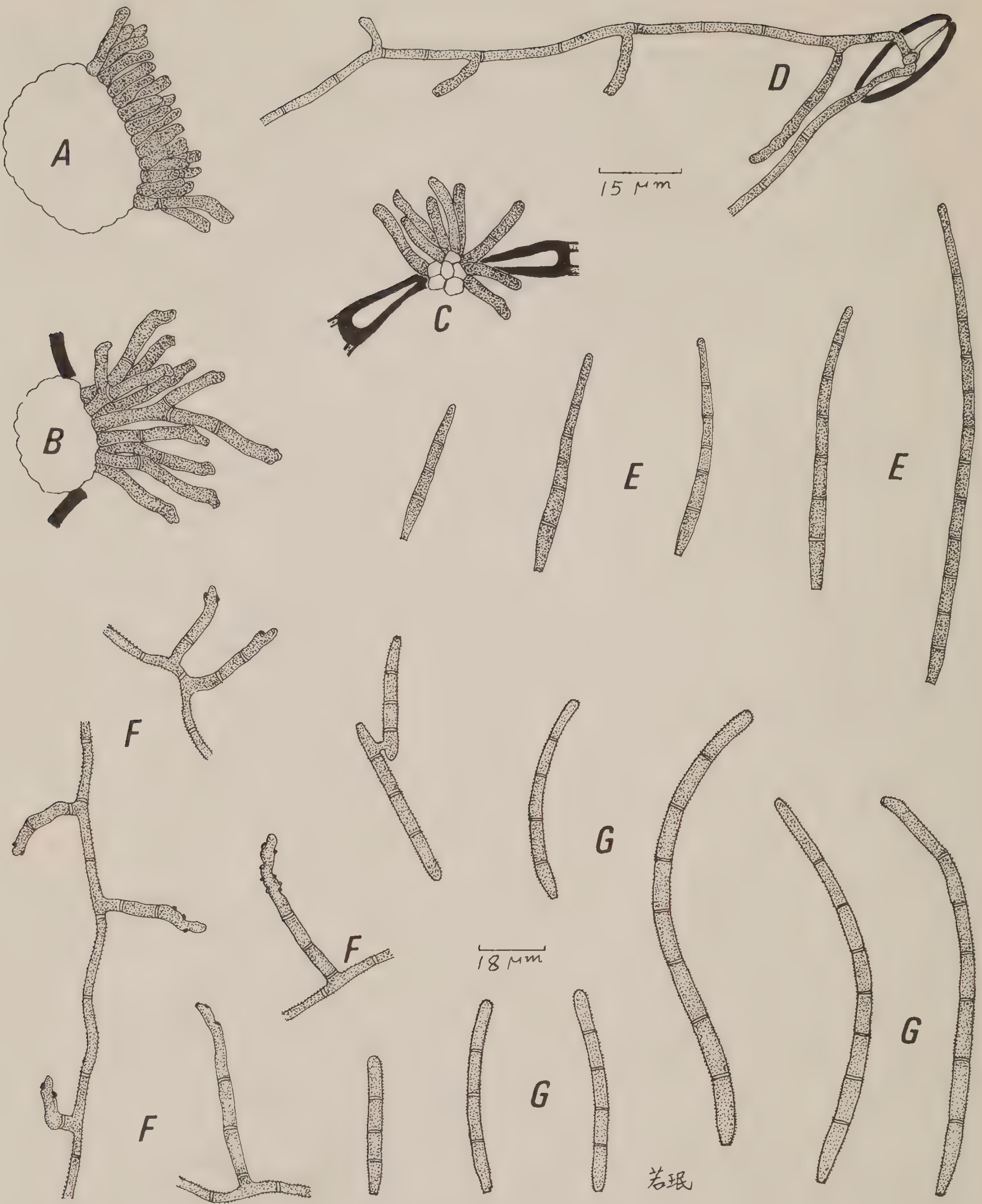
Fig. 6. Pseudocercospora vignigena Yen, Kar & Das: A, Young conidiophores; B, Fascicles of old conidiophores; C, External hyphae and formation of secondary conidiophores; E, Conidia.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repent or arcuate, very pale olivaceous, smooth, septate, bearing secondary conidiophores as lateral branches. Conidia very pale olivaceous, obclavate-cylindric, straight or slightly curved, smooth, not constricted, 3-11 septate, apex rounded or subrounded, base obconic-truncate, 36-82 x 2.5-3.5µm.

On *Vitis* sp. (Vitidaceae), in Hemtabad forest, West Dinajpur, West Bengal, India. Leg. B. K. Das, 10 October 1980, No Pcc4418 (Herb. LAM, Yen #10577).

Note: The indistinct leaf spots, amphigenous fruiting, and narrow pale olivaceous conidia separate this species from others on *Vitis*.

12. *Stenella* *canthii* Yen, Kar & Das, sp. nov. (Fig. 7, F&G)

Maculis distinctis, orbicularis vel irregulariter orbicularis, brunneo-albis et zona lata obscure brunnea restrictis, 2-10 mm diam., interdum confluentibus, usque 17mm longis. Caespitulis districte hypophyllis, invisibilis. Mycelium primarium immersum: hyphis pallidissime olivaceis, septatis, ramosis, 1.5-3µm latis. Stromatibus nullis. Conidiophoris solitariis, ex hyphis secundariis oriundis, brunneo-olivaceis vel pallide olivaceis, erectis vel leniter flexuosis, simplicibus, laevis, 1-3 septatis, 0-1 geniculatis, antice attenuatis, denticulatis et cicatricibus atro-brunneis ornatis, 21-45 x 3-3.5µm. Mycelium secundarium superficiale: hyphis ex stromatibus oriundis, pallide olivaceis, repentis vel arcuatis, subtiliter verruculosis, septatis, conidiophoris solitariis lateraliter gerentis. Conidiis plerumque cylindraceis, interdum obclavato-cylindraceis, pallide olivaceis, subtiliter verruculosis, plerumque curvatis, raro rectis, 1-7 septatis, ad apicem rotundatis, inferne attenuatis et in hilum truncatum, 18-112 x 3-4.5µm.

Habitat in foliis vivis *Canthii* *dedymi* Roxb. (Rubiaceae), ad Baraipur, 24-Parganas, *Bengal* *occidentalis*, India. Leg. B. K. Das, 15 IX 1980, No. Pcc4374 (Herb. LAM, Yen #10590), typus.

Leaf spot distinct, brown whitish, with a wide indistinct dark brown margin, 2-10mm in diameter, sometimes confluent up to 17mm long. Caespituli strictly hypophyllous, invisible. Primary mycelium internal: hyphae very pale olivaceous, septate, branched, 1.5-3µm wide. Stromata absent. Conidiophores arising from secondary hyphae as lateral branches, brown olivaceous or pale brown olivaceous, straight or slightly flexuous, simple, smooth, 1-3 septate,

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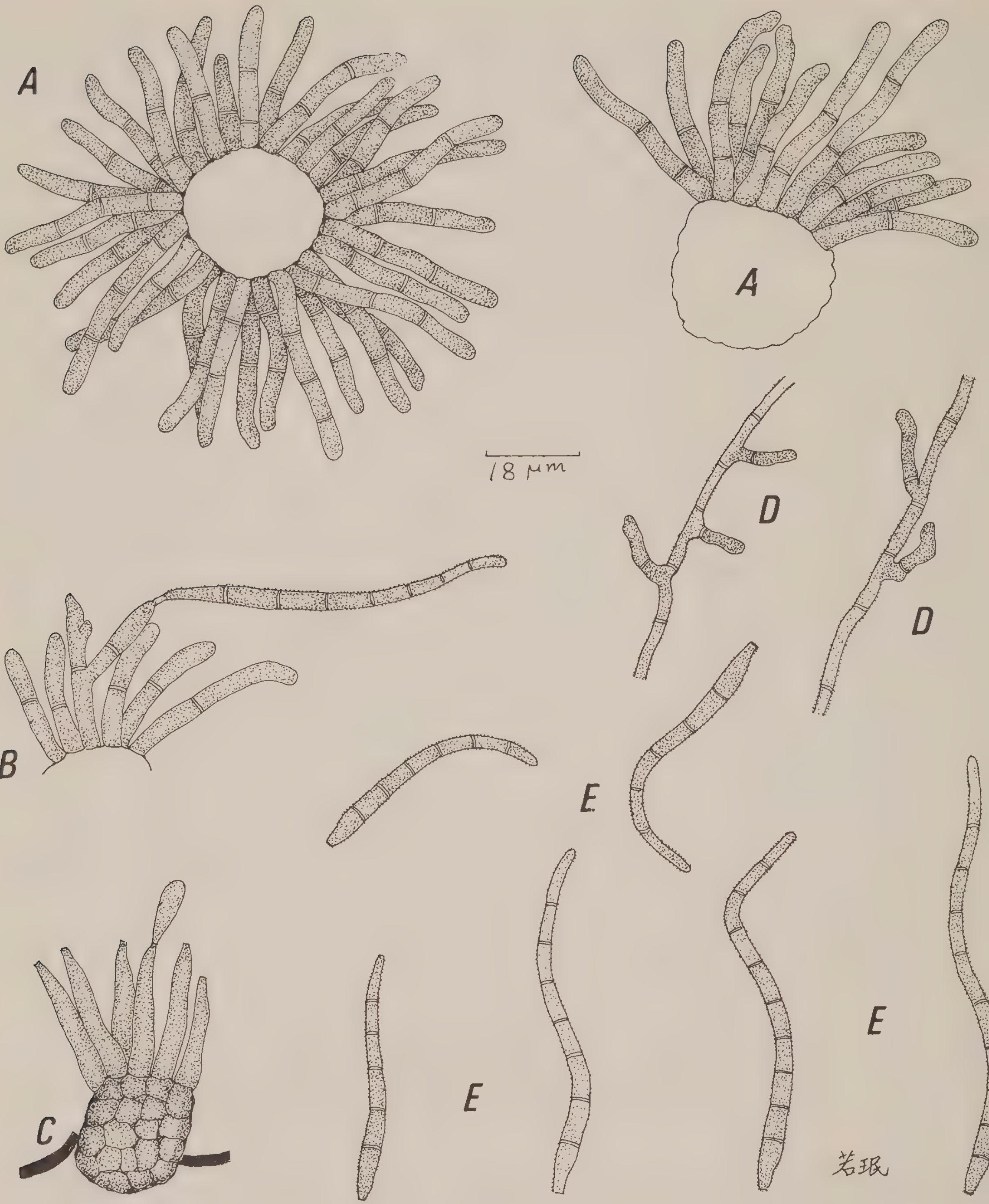
Fig. 7. A-E, *Pseudocercospora* *vitigena* Yen, Kar & Das: A, Young *conidiophores*; B, *Branched* *conidiophores*; C, Poor fascicles of conidiophores; D, External hyphae and formation of secondary conidiophores; E, Conidia. F-G, *Stenella* *canthii* Yen, Kar & Das: F, External hyphae *and* *formation* *of* normal conidiophores; G, Conidia.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not geniculate, apex attenuate, denticulate and decorated with dark brown conidial ciccatrices, 21-45 x 3-3.5μm. Secondary mycelium external: hyphae arising from stomata, pale olivaceous, repent or arcuate, finely verruculose, septate, bearing laterally the normal conidiophores. Conidia generally cylindric, sometimes obclavate-cylindric, pale olivaceous, finely verruculose, slightly curved, sometimes straight, 1-7 septate, apex rounded, base attenuate-truncate, 18-112 x 3-4.5μm.

On Canthium dedymum Roxb. (Rubiaceae), in Baraipur, 24-Parganas, West Bengal, India. Leg. B. K. Das, 15 September 1980, No Pcc4374 (Herb. LAM, Yen #10590).

13. Stenella dioscoreicola Yen, Kar & Das, sp. nov. (Fig. 8)

Maculis irregulariter orbicularis, brunneis, margine indistinctis, dispersis, 3-12mm diam. Caespitulis districte hypophyllis, in hypophyllo obscure punctiformibus. Mycelium primarium immersum: hyphis pallidissime olivaceis, septatis, romosis, 1.5-3.5μm latis. Stromatibus atro-brunneis, irregulariter globosis, 24-40μm diam. Conidiophoris hypophyllis, 12-40 in fasciculo per stomatibus emergentis, pallide brunneo-olivaceis, sursum pallidioribus, simplicibus vel raro ramosis, cylindraceis, erectis vel leniter flexuosis, 0-3 septatis, non geniculatis, ad apicem rotundatis, cicatricibus conidialis indistinctis, 17-80 x 4-5μm. Mycelium secundarium superficiale: hyphis parvum explicatis, cum conidiophoris primariis commixa in fasciculo per stomatibus emergentis, pallide olivaceis, repentis, septatis, ramosis, subtiliter verruculosis, 2-3μm latis, conidiophoris secundariis lateraliter raro gerentis. Conidiis pallide brunneo-olivaceis, obclaviformis vel obclavato-cylindraceis, plerumque curvatis vel undulatis, subtiliter verruculosis, 3-9 septatis, apice obtusis vel rotundatis, basi obconico-truncatis, 50-130 x 3.5-4.5(-5)μm.

Habitat in foliis vivis Dioscoreae sp. (Dioscoreaceae), ad Sylva Chelapata Cooch Behar, Bengal occidentalis, India. Leg. B. K. Das, 17 X 1980, Pcc4452 (Herb. LAM, Yen #10578), typus.

Leaf spot irregular orbicular, brown with an indistinct margin, scattered, 3-12mm in diameter. Caespituli strictly hypophyllous, visible under hand lens as dark punctiform. Primary mycelium internal: hyphae very pale olivaceous, septate, branched, 1.5-3.5μm wide. Stromata dark brown, irregularly globular, 24-40μm in diameter. Conidiophores hypophyllous, 12-40 in fascicles, arising from a stomata, generally simple, rarely branched, cylindric, straight or slightly flexuous, pale brown olivaceous, paler towards the tip, 0-3 septate, not geniculate, apex rounded, conidial

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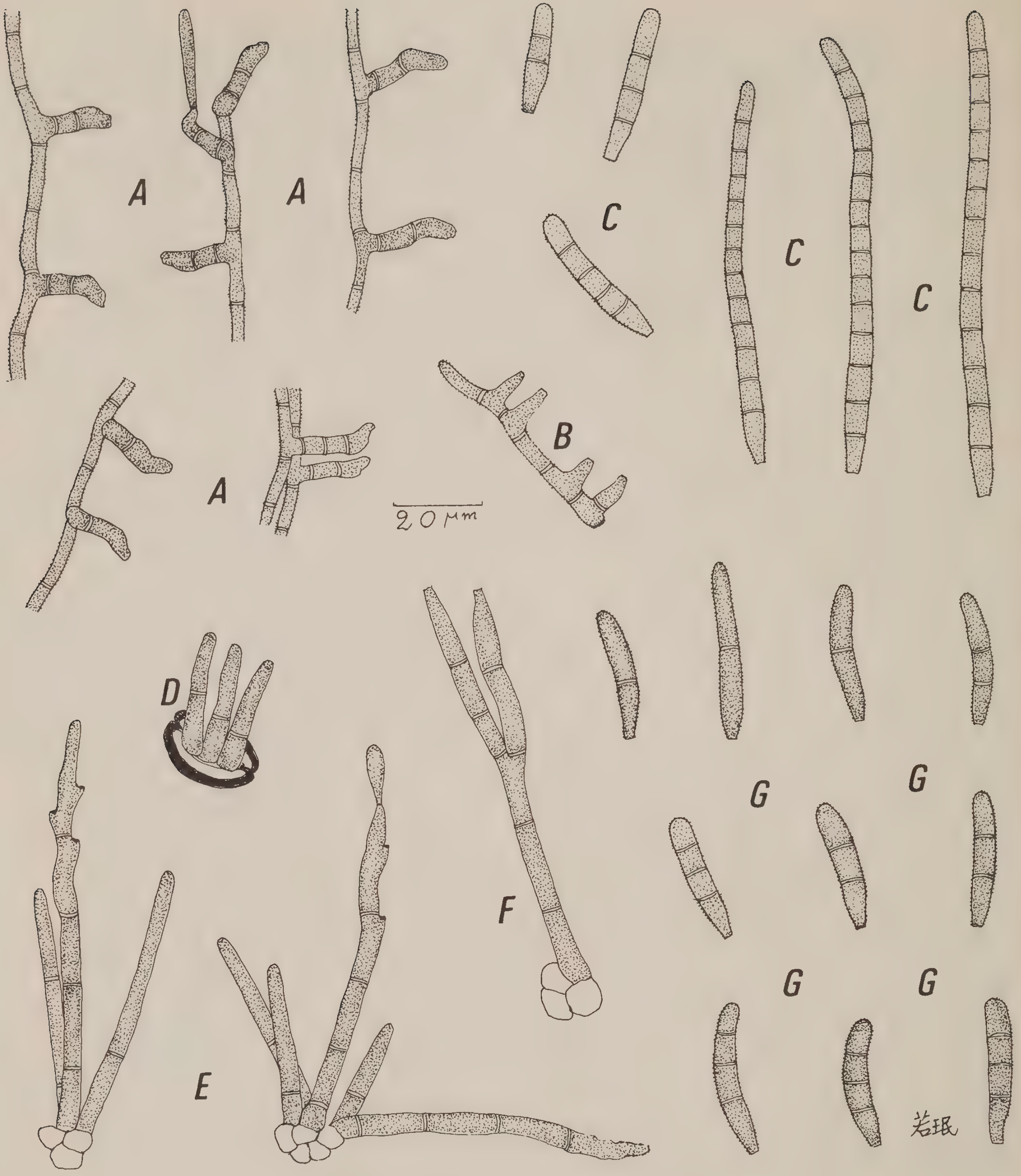
Fig. 8. Stenella dioscoreicola Yen, Kar & Das: A, Fascicles of primary conidiophores; B, Branched conidiophores; C, Young conidiophores; D, External hyphae and formation of secondary conidiophores; E, Conidia.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scars indistinct, 17-80 x 4-5μm. Secondary mycelium superficial: hyphae very poorly developed, mixing with the primary conidiophores and arising from a stomata, pale olivaceous, repent, septate, branched, finely verruculose, 2-3μm wide, bearing occasionally the secondary conidiophores as lateral branches. Conidia pale brown olivaceous, obclaviform or obclavate-cylindric, generally curved or undulated, finely verruculose, 3-9 septate, apex obtuse or rounded, base obconici-truncate, 50-130 x 3.5-4.5(-5)μm.

On Dioscorea sp. (Dioscoreaceae), in Forest of Chelapata, Cooch Behar, West Bengal, India. Leg. B. K. Das, 17 October 1980, No Pcc4452 (Herb. LAM, Yen #10578).

14. Stenella myxa (Sydow in Sydow & Mitter) Yen, Kar & Das comb. nov. (Fig. 9, A-C)
=Cercospora myxa Sydow in Sydow and Mitter, Ann. Mycol. 33:70, 1935.

Leaf spot indistinct or none. Caespituli strictly hypophyllous, in effuse dark olivaceous irregular patches. Primary mycelium internal: hyphae almost colorless, septate, branched, 1.5-3μm wide. Stromata not developed. Conidiophores hypophyllous, solitary, arising as lateral branches on the external mycelial hphae, pale brown olivaceous, simple continuous or 1-2 septate (rarely 3), smooth, substraight below, sinuous or subgeniculate towards the tip, apex attenuate and rounded, 13-26 x 5-6μm. Conidia cylindric, brown olivaceous or pale brown olivaceous, straight or slightly curved, finely verruculose, 2-14 septate (Chupp:2-12 septate), apex rounded, base attenuate and truncate, 24-110 x 5-6μm.

On Cordia myxa L. (Boraginaceae), in Kamarkundu, Nnoia, West Bengal, India. Leg. B. K. Das, 23 February 1980, No Pcc4234 (Herb. LAM, Yen #10587).

Note: We have sent the material of this species to the Commonwealth Mycological Institute in Kew, England, and it has been identified as a Stenella sp. According to the description of Cercospora myxa Sydow in Sydow and Mitter, which parasitizes also Cordia myxa in India, we find it is similar to our fungus.

15. Stenella stephaniae Yen, Kar & Das, sp. nov. (Fig. 9, D-G)
Maculis brunneis, angularis, per nervuli limitatis, in epiphyllo plus visibilis, dispersis, 1-2mm diam. Caespitulis hypophyllis invisibilis. Mycelium primarium immersum: hyphis fere incoloris, septatis, ramosis, 2.5-4.5μm latis. Stromatibus atro-brunneis, globosis

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Fig. 9. A-C, Stenella myxa (Sydow in Sydow & Mitter) Yen, Kar & Das: A, External hyphae and formation of conidiophores; C, Conidia. D-G, Stenella stephaniae Yen, Kar & Das: D, Young conidiophores; E, Conidiophores and formation of conidia; F, Branched conidiophores; G, Conidia.

10-45μm diam. Conidiophoris hypophyllis, ex stomatibus oriundis, 2-8 in fasciculotis, pallide brunneo-olivaceis, simplicibus, interdum ramosis, laevis, erectis, 1-4 septatis, apex rotundatis vel attenuatis et denticulatis, cicatribus sporarum atro-brunneis manifestibus, 25-120 x 4-5μm. Conidiis breviter cylindraceis, pallide brunneo-olivaceis, leniter curvatis, 1-3 septatis, ad apicem rotundatis, basi attenuatis et truncatis, 31-45 x 5-7μm.

Habitat in foliis vivis Stephania hernandifolia Walp. (Menispermaceae), ad Raganj, Dinajpur occidentalis, Bengal occidentalis, India. Leg. B. K. Das, 24 X 1979, No. Pc 4231 (Herb. LAM, Yen #10591), typus.

Leaf spot small, brown, angular and vein-limited, more distinct on upper surface, scattered, 1-2mm in diameter. Caespituli strictly hypophyllous, invisible even under hand lens. Primary mycelium internal: hyphae almost colourless, septate, branched, 2.5-4.5μm wide. Stromata dark brown, globular, 10-45μm in diameter. Conidiophores hypophyllous, emerging through the stomata, 2-8 in poor fascicles, rather pale olivaceous and paler towards the tip, smooth, usually simple, occasionally branched, straight below, slightly flexuous above, 1-4 setate, not geniculate, apex rounded or attenuate and denticulate, dark-brown cicatrices conidial decorated on the shoulders, 25-120 x 4-5μm. Conidia shortly cylindric, pale brown-olivaceous, slightly curved, 1-3 septate, apex rounded, base attenuate- truncate, 31-45 x 5-7μm.

On Stephania hernandifoloa Walp. (Meninspermaceae), in Raganj, Wet Dinajpur, West Bengal, India. Leg. B. K. Das, 24 October 1979, No Pcc 4231 (Herb. LAM, Yen #10591).

Note: We have sent the material of this fungus to the Commonwealth Mycological Institute in Kew, England, and it has been identified as a Stenella sp. Although CMI has not mentioned the species name, we consider it as a new one.

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STUDIES ON HYPHOMYCETES FROM WEST BENGAL, INDIA, II. CERCOSPORA AND ALLIED GENERA OF WEST BENGAL, 2

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ABSTRACT

This study includes descriptions and illustrations of nine new species and two new combinations of Indian Cercosporae: *Pseudocercospora brideliicola* sp. nov., on *Bridelia* sp.; *P. micheliicola* sp. nov., on *Michelia champaca*; *P. oroxyligena* sp. nov., on *Oroxylum indicum* *P. pavettae-indicae* (Gov. & Thirum.) comb. nov., on *Pavetta indica; P. stillingiae* (Ell. & Ev.) comb. nov., on *Sapium sebiferum; P. tectonicola* sp. nov., on *Tectona grandis; P. viticigena* sp. nov., on *Vitex negundo; Stenella coffeae* sp. nov., on *Coffea bengalensis; S. garugae* sp. nov., on *Gargua pinnata; S. oroxylicola* sp. nov., on *Oroxylum indicum;* and *S. xeromphigena* sp. nov., on *Xeromphis uliginosa.*

1. Pseudocercospora brideliicola Yen, Kar & Das, sp. nov. (Fig. 1)

Maculis indistinctis, Caespitulis hypophyllis, effusis, velutinis, griseis, mox interdum confluentis et in inferiore superficie saepe fere totam folii paginam omnino obtegentis. Mycelium primarium immersum: hyphis pallidissime olivaceis, septatis, ramosis, 3-4 µm latis. Stromatibus nullis vel parvis, substomatalis, ex hyphis paucis et subhyalinis compositis. Conidiophoris 2-15 in fasciculo per stomatibus emergentis, divergentis, laevis, olivaceis et sursum pallidioris, simplicibus, interdum ramosis, erectis vel leniter flexuosis, 2-10 septatis, 0-2 geniculatis, superne interdum denticulatis, ad apicem rotundatis vel attenuatis, cicatricibus conidialis interdum visibilis (1.5-2.5 µm diam.), 40-180 (-250) x 5-6 µm. Mycelium secundarium superficiale: hyphis pallide olivaceis, ex stomatibus et conidiophoris primariis oriundis, septatis, ramosis, laevis, 2.5-3 µm latis, conidiophoris secundariis lateraliter manifestibus. Conidiis obclavato-cylindraceis, pallide olivaceis, rectis vel leniter curvatis, plerumque 3 septatis (raro 1 vel 4 septatis),

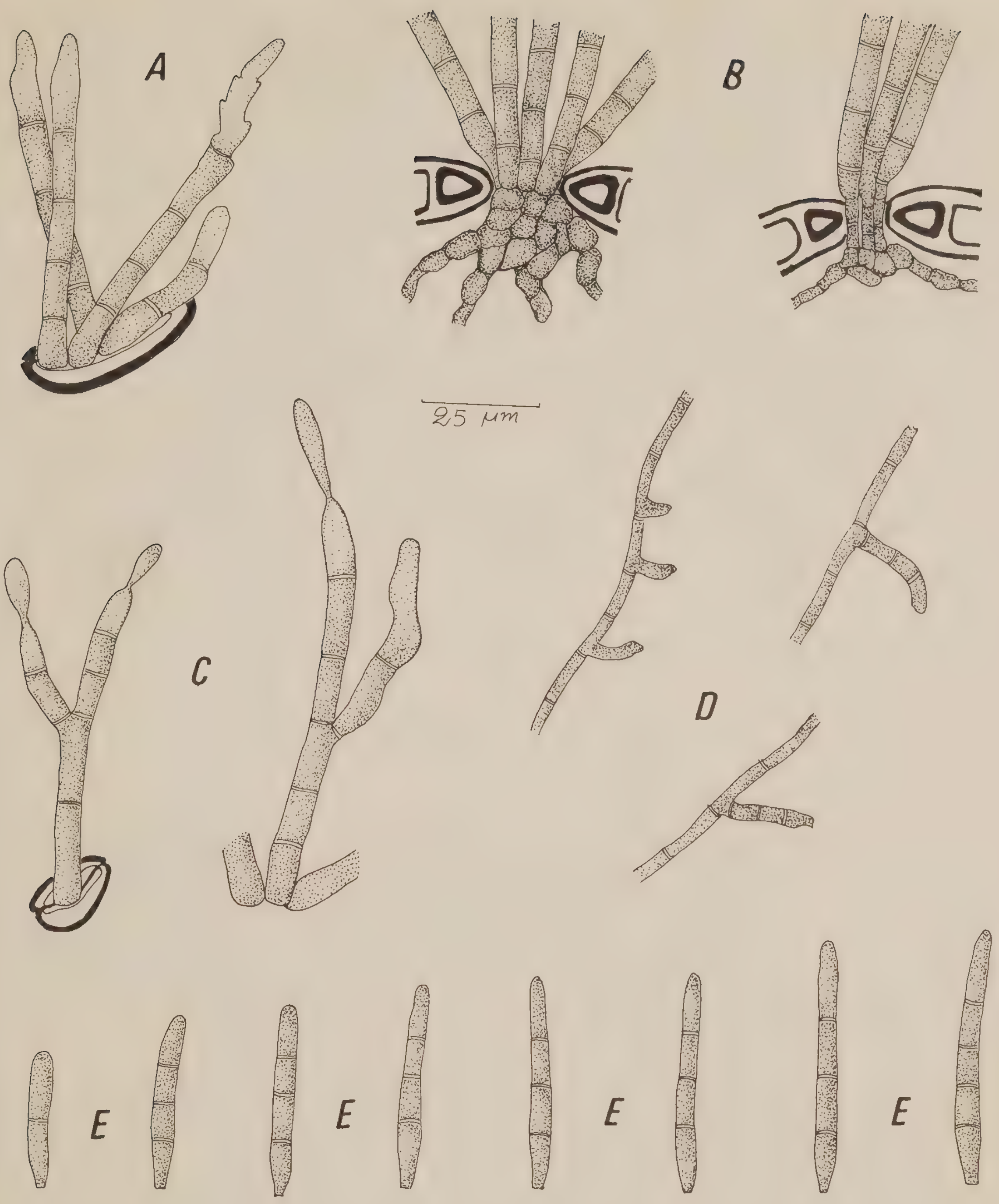

Fig. 1. Pseudocercospora brideliicola: A, Young conidiophores; B, Rudimentary stromata; C, Formation of conidia; D, Formation of secondary conidiophores; E, Conidia.

apice rotundatis, basi obconico-truncatis, 21-67 x 4.5-5 µm.

Habitat in foliis vivis *Brideliae* sp. (Euphorbiaceae), ad Bibirhat, 24-Parganas, Bengal occidentalis, India, leg. B.K. Das, 10 I 1980, No. PCC 4125 (IMI 250379) (Herb. LAM Yen #10601, holotypus).

Leaf spot indistinct or none, Caespituli hypogenous, effuse, velutinous, grayish, sometimes extending and covering all the under surface of the leaf. Primary mycelium internal: hyphae very pale olivaceous, septate, branched, 3-4 µm wide. Stromata absent or very rudimentary, only a loose mass of subhyaline internal hyphae under the stomata. Conidiophores 2-12 in fascicles emerging through the stomata, olivaceous below and paler or subhyaline towards the tip, simple, sometimes branched, 2-10 septate, 0-2 geniculate, sometimes denticulate above, apex rounded or attenuate, conidial scars visible on the shoulder or at the end of denticles, 40-180 (-250) x 5-6 µm. Secondary mycelium superficial: hyphae pale olivaceous arising from the stomata or from the prolongation of primary conidiophores, septate, branched, 2.5-3 µm wide, often bearing the short secondary conidiophores as lateral branches. Conidia obclavate-cylindric, pale olivaceous, straight or very slightly curved, generally 3 septate, rarely 1 or 4 septate, apex rounded, base obconic and attenuate-truncate, 21-67 x 4.5-5 µm.

On *Bridelia* sp. (Euphorbiaceae), in Bibirhat, 24-Parganas, West Bengal, India, leg. B.K. Das, 10 I 1980, No. PCC 4125 (IMI 250379) (Herb. LAM Yen #10601).

Note: Sawada (1943) has described in Taiwan, *Cercospora atridis* Syd., which parasitizes the leaves of *Bridelia monoica* (Lour.) Merr.; it differs from this fungus by its dark-brown, wider conidia (7.5-8 µm compared with 4.5-5 µm). On the other hand, *Pseudocercospora brideliae* Deighton differs from this species by its much longer dark olivaceous conidiophores (up to 450 µm long) and by its condial septatum (3-15 septate compared with 3 septate).

2. *PSEUDOCERCOSPORA HIBISCI-CANNABINI* (Sawada) Deighton (Fig. 2) Mycol. Pap. 140:145, 1976 = ***Cercospora hibisci-cannabini*** Sawada, Descr. Cat. Formosan Fungi, 2:153, 1921.

Leaf spot indistinct, but some angular areas darkish, vein-limited, more visible on lower surface, scattered, 0.5-3 mm in diameter, sometimes confluent. Caespituli amphigenous, but chiefly hypophyllous, effuse, dark-gray, sometimes extensively velutinous on lower surface of the leaf. Primary mycelium internal:hyphae subhyaline, septate, branched, 2.3-5 µm wide. Stromata absent or very rudimentary. Conidiophores emerging through the stomata, pale olivaceous, forming dense to very dense fascicles above the stomata, pale olivaceous, forming dense to very dense fascicles above the stomata, simple or branched, flexuous, rarely straight, 1-7 septate, apex rounded, or attenuate-truncate and sometimes shouldered, 14-40 x 3-3.5 µm. Secondary mycelium superficial: hyphae pale olivaceous, septate, branched, 2-4 µm wide, bearing secondary conidiophores as lateral branches.

Conidia obclavate-cylindric, very pale olivaceous, straight or slightly curved, 1-9 septate (Sawada: 3-9 septate), apex rounded, base obconic-truncate or attenuate-truncate, 21-75 x 3-3.5 (-4) μm (Sawada: 40-88 x 3-3.5 μm).

On *Hibiscus rosa-sinensis* L. (Malvaceae), in Raiganj, West Dinajpur, West Bengal, India, leg. B.K. Das, 15 IX 1980, No. PCC 3802 (IMI 250373) (Herb. LAM Yen #10599).

Note: *Pseudocercospora abelmoschi* (Ell. & Ev.) Deighton differs from this species by its wider conidia (3-7 μm compared with 3-3.5 μm). But all the systematic characters of this fungus are similar to those of *Pseudocercospora hibisci-cannabini* (Sawada) Deighton, which have been well described and illustrated by Sawada (1921).

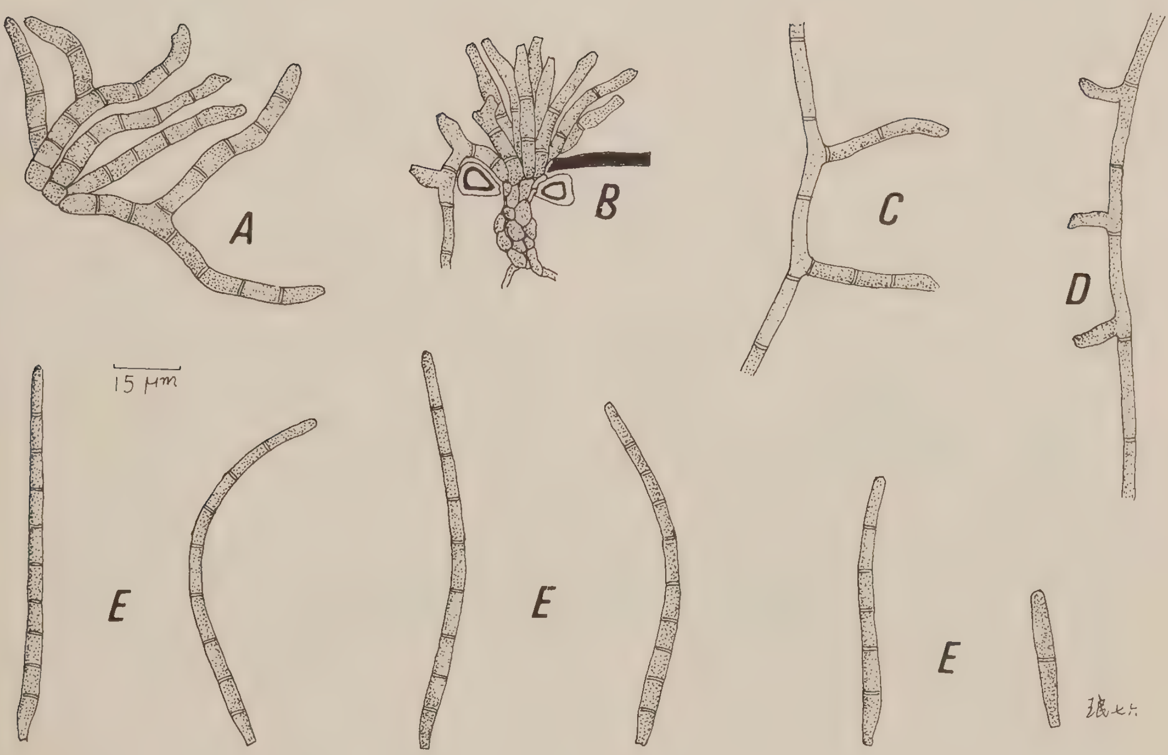

Fig. 2. Pseudocercospora hibisci-cannabini: A, Old and branched conidiophores; B, Formation of secondary mycelial hyphae; C & D, Secondary conidiophores; E, Conidia.

3. **Pseudocercospora micheliicola** Yen, Kar & Das, sp. nov. (Fig. 3)

Maculis distinctis, angularis, nervuli limitatis, interdum irregularis, mediocriter brunneis, autem albo-griseis in medio, dispersis, 2-5 mm diam., in inferiore superficie minus distinctis. Caespitulis amphiphyllis, autem principaliter epiphyllis, punctiformis, atro-brunneis, in superiore superficie distributis. Mycelium immersum: hyphis pallide olivaceis, laevis, septatis, ramosis, 2.5-4.5 µm latis. Stromatibus atrobrunneis, globosis vel subglobosis, 20-50 µm diam. Conidiophoris numerosis in dense vel valde dense fasciculo per stomatibus emergentis, mediocriter olivaceis vel pallide olivaceis, sursum pallidioris, laevis, simplicibus, semper tortuosis vel sinuosis, 0-3 septatis, 0-2 geniculatis, ad apicem rotundatis vel attenuatis, cicatricibus conidialis indistinctis, 10-55 x 4-5 µm. Conidiis obclaviformibus, olivaceis vel mediocriter olivaceis, rectis vel curvatis, 4-10 septatis, laevis, non constrictis, apice subacutis vel obtusis, basi obconico-truncatis, 55-120 x 5.5-7 µm.

Habitat in foliis vivis *Micheliae champacae* L. (Magnoliaceae), ad Rajahatkhawa Sylva, Alipurduar, Jalpaiguri, Bengal occidentalis, India, leg. B.K. Das, 17 x 1980, No. PCC 4420 (Herb. LAM Yen #10603, holotypus).

Leaf spot distinct, angular, vein-limited, sometimes irregular, mid brown with a grayish white center, 2-5 mm in diameter, scattered, more visible on upper surface. Caespituli amphigenous, but chiefly epiphyllous, punctiform, black brown, loosely distributed over the spot on upper surface. Mycelium internal: hyphae pale olivaceous, smooth, septate, branched, 2.5-4.5 µm wide. Stromata well developed, dark brown, globular, or subglobular, 20-50 µm in diameter. Conidiophores emerging through the stomata, numerous in dense or very dense fascicles, mid olivaceous to pale olivaceous, but very pale olivaceous or subhyaline towards the tip, smooth, simple, always tortuous with a sinuous membrane, 0-3 septate, 0-2 geniculate, apex rounded or shouldered and attenuate, conidial scars not distinct, 10-55 x 4-5 µm. Conidia obclaviform, olivaceous or mid olivaceous, straight or curved, smooth, not constricted, 4-10 septate, apex subacute or obtsue, base obconic-truncate, 55-120 x 5.5-7 µm.

On *Michelia champaca* L. (Magnoliaceae), in Rajabhatkhawa Forest, Alipurduar, Jalpaiguri, West Bengal, India, leg. B.K. Das, 17 X 1980, No. PCC 4420 (Herb. LAM Yen #10603).

Note: *Cercospora micheliae* Boedijn differs from this fungus by its conidiophores only arising from the external mycelial hyphae, without stromata, and especially by its much narrower conidia (3.5-4.5 µm wide compared with 5.5-7 µm wide).

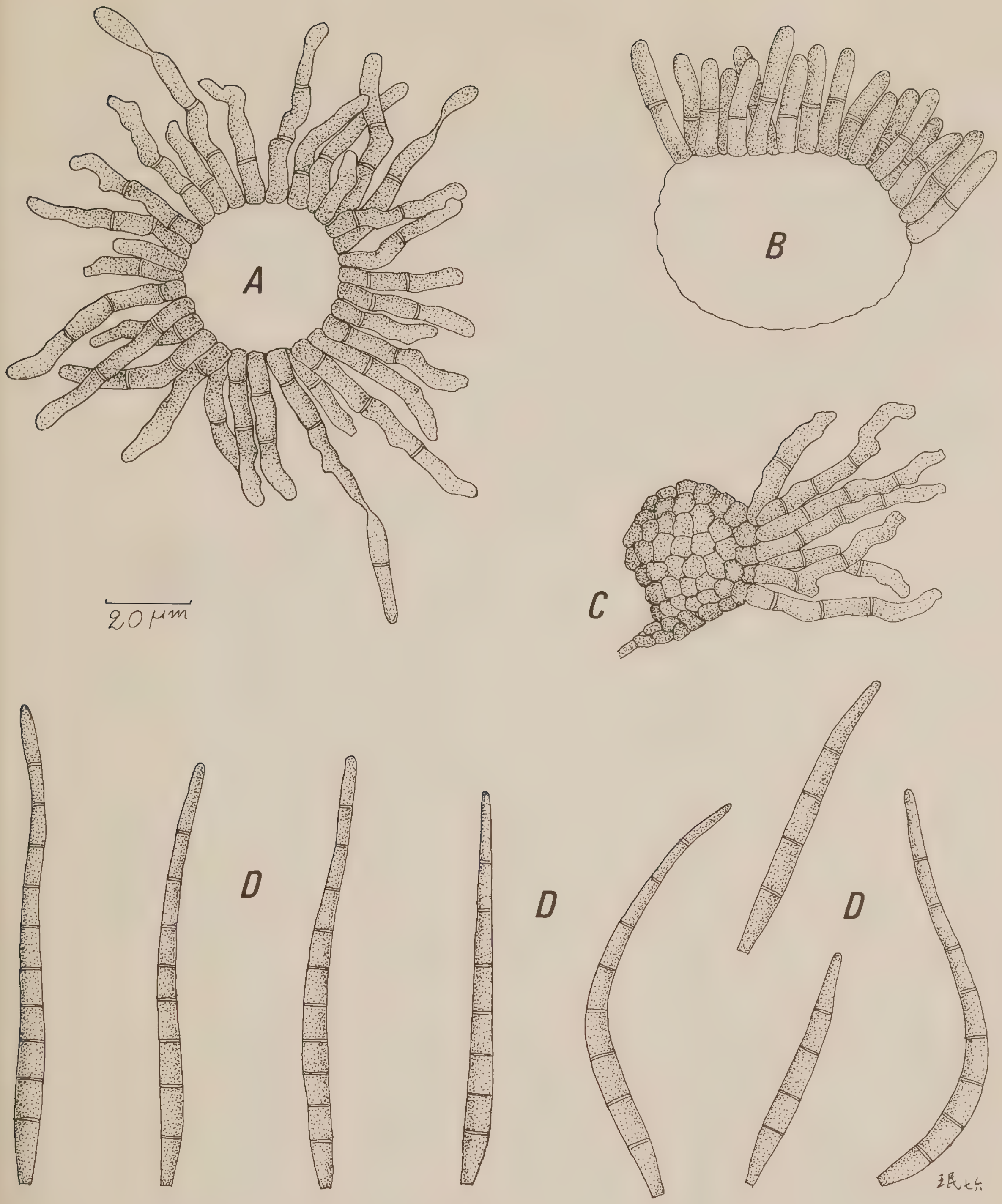

Fig.3. Pseudocercospora micheliicola: A, Conidiophores and formation of conidia; B, Young conidiophores; C, Old conidiophores and stromata; D, Conidia.

4. Pseudocercospora oroxyligena Yen, Kar & Das, sp. nov. (Fig. 4)

Maculis indistinctis, tandem areae parvae angularis, nervuli limitatis, rufo-brunneis, 2-5 mm diam., in inferiore superficie invisibilis. Caespitulis districte hypophyllis, invisibilis. Mycelium immersum: hyphis pallide olivaceis, laevis, septatis, ramosis, 2.5-4.5 µm latis. Stromatibus nullis. Conidiophoris solitariis vel 2-3 in fasciculo per stomatibus emergentis, pallide olivaceis, sursum pallidioris (fere hyalinis), simplicibus, erectis vel leniter curvatis, 0-3 septatis, non geniculatis, apex rotundatis vel attenuatis, interdum truncatis, cicatricibus conidialis interdum visibilis (2 µm diam.), 50-100 x 7-9 µm. Conidiis cylindraceis, fusiformis vel obclavato-cylindraceis, pallide olivaceis, rectis vel leniter curvatis, laevis, frequentissime constrictis, 1-5 septatis, apice rotundatis, basi attenuatis et truncatis, 24-87 x 7-9 µm.

Habitat in foliis vivis *Oroxyli indici* Vent. (Bignoniaceae), ad Garia, 24-Parganas, Bengal occidentalis, leg. B.K. Das, 26 XII 1979, No. PCC 4091a (IMI 256518a) (Herb. LAM Yen #10595, holotypus).

Leaf spot indistinct, only some pale reddish-brown angular discolored areas with indistinct margin, more or less vein-limited, scattered or confluent, 2-5 mm in diameter, more visible on upper surface, but invisible on lower surface. Caespituli strictly hypophyllous, invisible even under hand lens. Mycelium internal: hyphae pale olivaceous, smooth, septate, branched, 2.5-4.5 µm wide. Stromata lacking. Conidiophores solitary or 2-3 in fascicles emerging through the stomata, pale olivaceous and paler towards the tip (almost hyaline), simple, straight or slightly curved, 0-3 septate, not geniculate, apex rounded or attenuate and truncate, conidial scars sometimes visible (2 µm in diameter), 50-100 x 7-9 µm. Conidia cylindric, fusiform or obclavate-cylindric, pale olivaceous, straight or slightly curved, 1-5 septate, smooth, often constricted at septum, apex rounded, base attenuate and subtruncate, 24-87 x 7-9 µm.

On *Oroxylum indicum* Vent. (Bignoniaceae), in Garia, 24-Parganas, West Bengal, India, leg. B.K. Das, 26 XII 1979, No. PCC 4091a (IMI 256518a) (Herb. LAM Yen #10595).

Note: *Cercospora oroxyli* Kar & Mandal differs from this fungus by its hyaline and filiform conidia.

5. Pseudocercospora pavettae-indicae (Gov. & Thirum.) Yen, Kar & Das, comb. nov. (Fig. 5, A-E) = *Cercospora pavettae-indicae* Gov. & Thirum., Sydowia 10:271, 1957.

Leaf spot distinct, irregularly angular, more or less vein-limited, pale brown, sometimes without distinct margin, but sometimes with a linear raised dark-brown margin which is a discoloration of the limiting veins, scattered or confluent, 1-4 mm in diameter, clearer on upper surface. Caespituli amphigenous, visible as small dark punctiform bodies on both surfaces. Primary mycelium internal: hyphae pale olivaceous, smooth, branched, septate, 3-4 µm wide. Stromata well developed, black-brown, globular or subglobular, 25-50 µm in diameter. Conidiophores pale olivaceous, 5-25

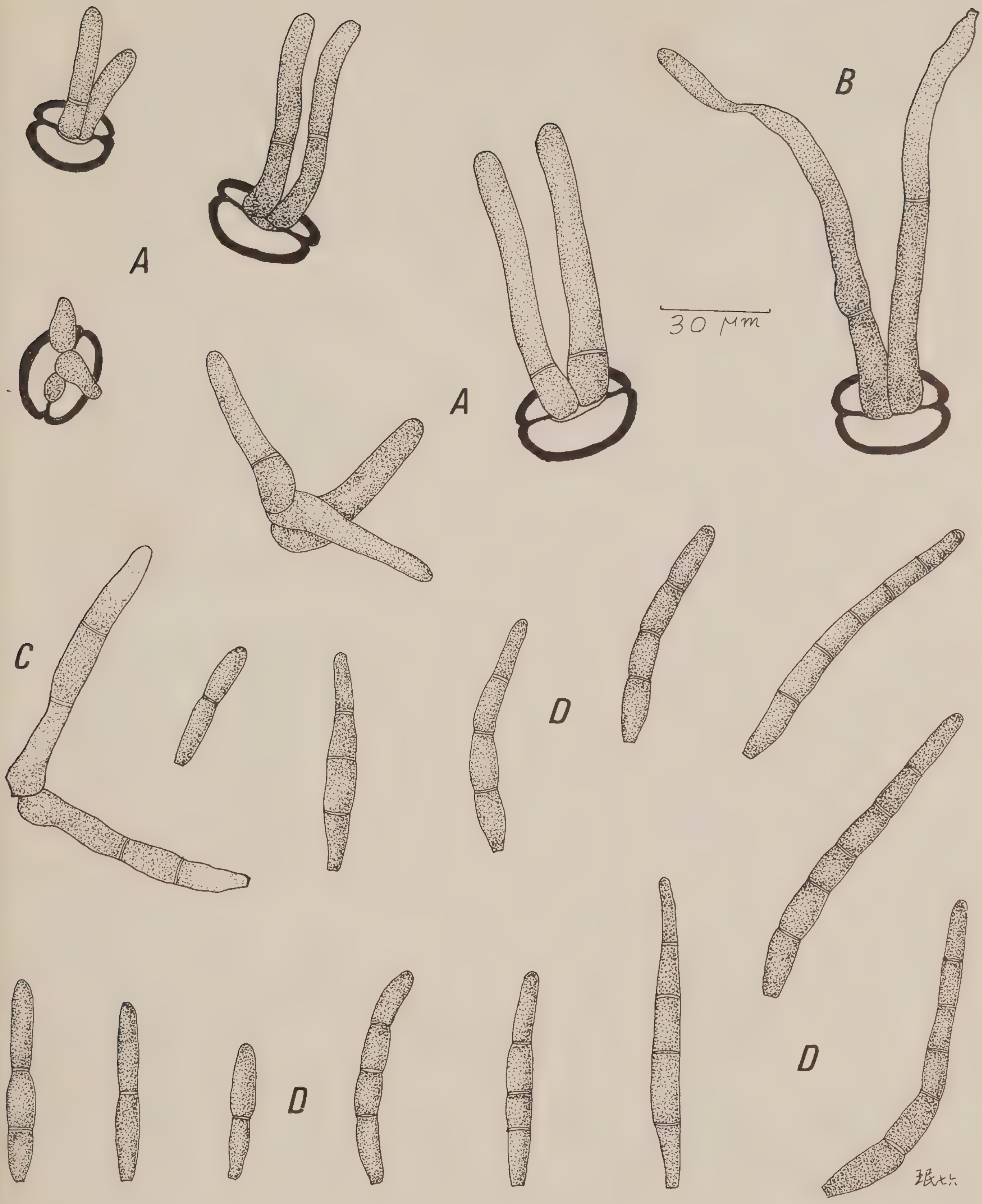

Fig. 4. Pseudocercospora oroxyligena: A, Young conidiophores; B, Formation of conidia; C, Old conidiophores; D, Conidia.

in fascicles emerging through the stomata, simple, straight when young, flexuous when old, 0-3 septate, 0-2 geniculate, sometimes with membrane finely rugose, apex rounded or attenuate and subtruncate, conidial scars not distinct, 12-50 x 4-5 (-6) µm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the stomata, septate, branched, 3-3.5 µm wide, bearing the secondary conidiophores as lateral branches. Conidia cylindric or obclavate-cylindric, pale olivaceous, straight or slightly curved, smooth, not constricted, 3-6 septate, apex rounded, base attenuate and truncate, 35-80 x 3-5 (-6) µm.

On *Pavetta indica* L. (Rubiaceae), in Amtalla, 24-Parganas, West Bengal, India, leg. B.K. Das, 23 IX 1979, No. PCC 3716 (IMI 242957) (Herb. LAM Yen #10596).

Note: The systematic characters of this fungus are those of *Cercospora pavettae-indicae* Gov. & Thirum, which Govindu and Thirumalachar (1957) have described. But for lack of thickened conidial scars, this fungus ought to be transferred to genus *Pseudocercospora (Ps. pavettae-indicae)*.

6. Pseudocercospora stillingiae (Ell. & Ev.) Yen, Kar & Das, comb. nov. (Fig. 5, F-I) = *Cercospora stillingiae* Ell. & Ev., Jour. Mycol. 3:20, 1887.

Leaf spot orbicular or suborbicular, deep brown, bordered by a yellowish zone without distinct margin, scattered, about 2-6 mm in diameter. Caespituli amphigenous, but chiefly hypophyllous, punctiform on lower surface of old spot, but not visible on young ones. Primary mycelium internal: hyphae olivaceous or pale olivaceous, branched, septate, 2-4 µm wide. Stromata well developed, dark brown, subglobular, 20-50 µm in diameter. Conidiophores numerous in dense fascicles emerging through the stomata, pale olivaceous and very pale olivaceous towards the tip, simple, flexuous, 0-3 septate, 0-2 geniculate, apex rounded or shouldered, conidial scars sometimes visible, 10-30 x 3-4 µm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the stomata, branched, septate, 2-4 µm wide, bearing the secondary conidiophores as lateral branches. Conidia cylindric or obclavate-cylindric, pale olivaceous, straight or slightly curved, smooth, not constricted, 0-4 septate (generally 3-4 septate), apex rounded, base obconic-truncate, 14-43 x 2.5-4 µm.

On *Sapium sebiferum* Roxb. (Euphorbiaceae), in Duttapurkur, 24-Parganas, West Bengal, India, leg. B.K. Das, 15 XII 1979, No. PCC 4061 (IMI 246496) (Herb. LAM #10598).

Note: This fungus shows the systematic characters of *Cercospora stillingiae* Ell. & Ev. On the other hand, Sawada (1943) has described a *Cercospora sapii-sebiferi* Sawada in Taiwan, but the description and the figures show that is a synonym of *Cercospora stillingiae* Ell. & Ev. But for lack of thickened conidial scars, this species ought to be transferred to genus *Pseudocercospora (Ps. stillingiae)*.

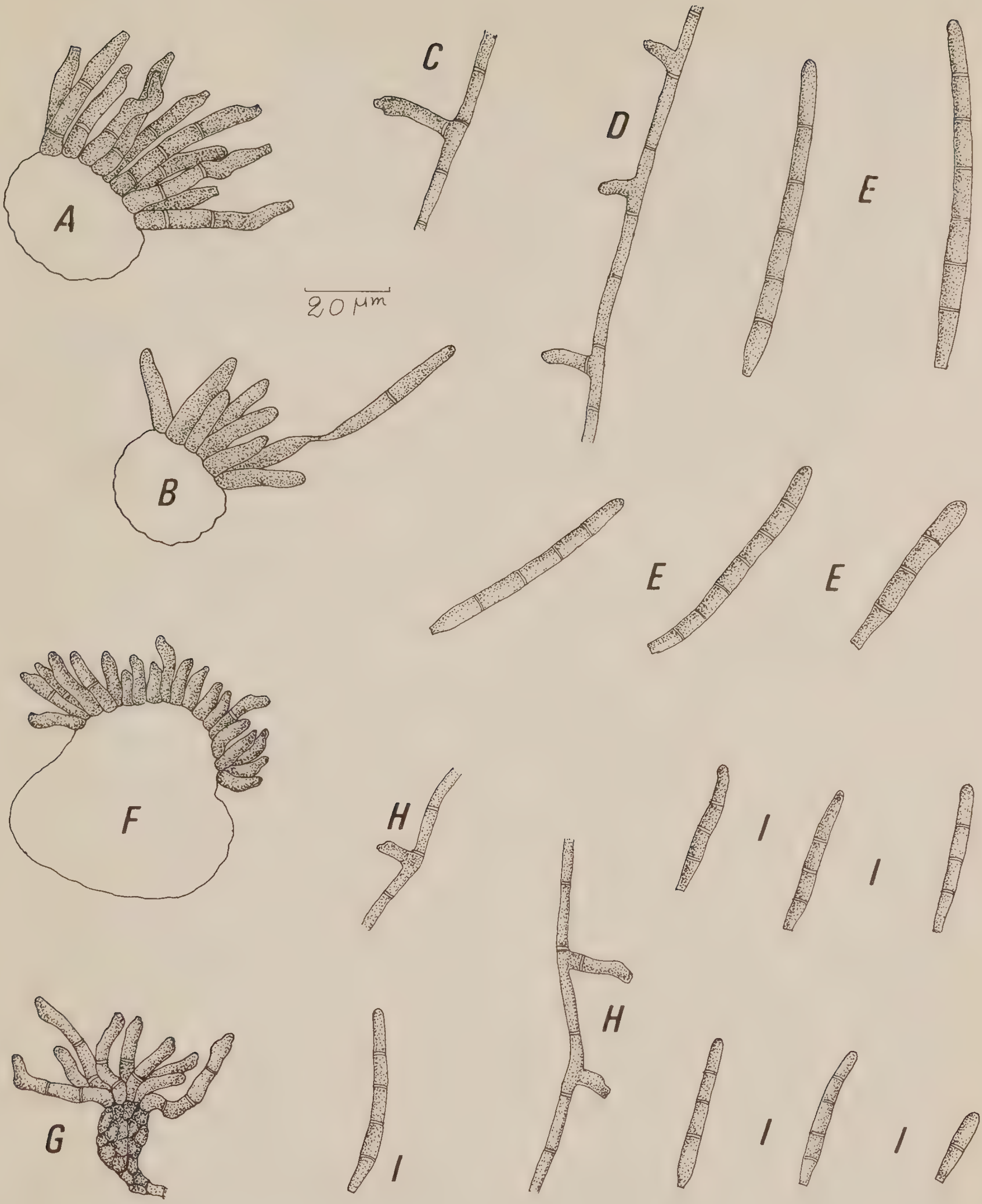

Fig. 5. Pseudocercospora pavettae-indicae(A-E): A, Primary conidiophores; B, Young conidiophores and fromation of conidia; C & D, Secondary conidiophores; E, Conidia.----Pseudocercospora stillingiae(F-I): F,Young conidiophores; C,Old conidiophores; H,Secondary conidiophores; I, Conidia.

7. Pseudocercospora tectonicola Yen, Kar & Das, sp. nov. (Fig. 6)

Maculis indistinctis, Caespitulis hypophyllis, effusis atro-brunneis, dense velutinis. Mycelium immersum: hyphis pallide olivaceis, laevis, septatis, ramosis, 2-4 µm latis. Stromatibus plerumque nullis, interdum mediocriter evolutis, atrobrunneis, subglobosis usque ad 20 µm diam. Conidiophoris hypophyllis, 2-12 in fasciculo per stomatibus emergentis, interdum solitariis, valde brunneis, sursum pallidioris, simplicibus, 0-12 septatis, non geniculatis, inferne erectis et laevis, superne leniter flexuosis et rugosis, ad apicem rotundatis vel subconicis, cicatricibus conidialis indistinctis, 36-120 x 5.5-8 µm. Conidiis obclavatis vel obclavato-cylindraceis, profunde brunneis, plerumque curvatis, raro rectis, 3-9 septatis, laevis, leniter constrictis, apice rotundatis, basi attenuatis et truncatis, 30-100 x 6.5-8 µm.

Habitat in foliis vivis *Tectonae grandis* L. (Verbenaceae), ad Santipur, Nadia, Bengal occidentalis, India, leg. B.K. Das, 28 XII 1979, No. PCC 4102 (IMI 246495) (Herb. LAM Yen #10597, holotypus).

Leaf spot indistinct or none. Caespituli hypophyllous, deep dark brown, effuse, densely velutinous. Mycelium internal: hyphae pale olivaceious, smooth, septate, branched, 2-4 µm wide. Stromata generally absent, sometimes poorly developed, dark-brown, subglobular, 20 µm in diameter. Conidiophores hypogenous, 2-12 in fascicles emerging through the stomata, sometimes solitary, deep-brown, paler towards the tip, simple, straight when young, slightly flexuous when old, 0-12 septate, not geniculate, smooth below, rugose and more or less undulated above, apex rounded or subconic and sometimes swollen, conidial scars not distinct, 36-120 x 5.5-8 µm. Conidia obclavate or obclavate-cylindric, deep-brown, generally slightly curved, sometimes straight, 3-9 septate, smooth, sometimes with constrictions at the septum, apex rounded, base attenuate-truncate, 30-100 x 6.5-8 µm.

On *Tectona grandis* L. (Verbenaceae), in Santipur, Nadia, West Bengal, India, leg. B.K. Das, 28 XII 1979, No. PCC 102 (IMI 246495) (Herb. LAM Yen #10597).

Note: The *Cercospora tectonae* Stevens differs from this fungus in having hyaline conidia.

8. Pseudocercospora viticigena Yen, Kar & Das, sp. nov. (Fig. 7)

Maculis aliquantum distinctis, atro-brunneis, in epiphyllo plus visibilis, suborbicularis, angularis vel irregularis, dispersis, 1-3 mm diam., interdum usque ad 4 mm longis. Caespitulis hypophyllis, invisibilis. Mycelium primarium immersum: hyphis subhyalinis vel pallidissime olivaceis, laevis, septatis, ramosis, 1.5-3.5 µm latis. Stromatibus atro-brunneis, irregulariter globosis, 24-40 µm diam. Conidiophoris districte hypophyllis, numerosis in dense fasciculatis, pallide olivaceis et sursum pallidioris, simplicibus, 0-3 septatis, 0-2 geniculatis, saepe flexuosis, in superne interdum denticulatis, ad apicem attenuatis vel irregulariter rotundatis, cicatricibus conidialis interdum visibilis, 15-43 x 3-4 (-5) µm. Mycelium secundarium sperficiale: hyphis ex stomatibus oriundis, pallidissime olivaceis, laevis, septatis, ramosis, 2.5-3 µm latis, conidiophoris secundariis lateraliter gerentis. Con-

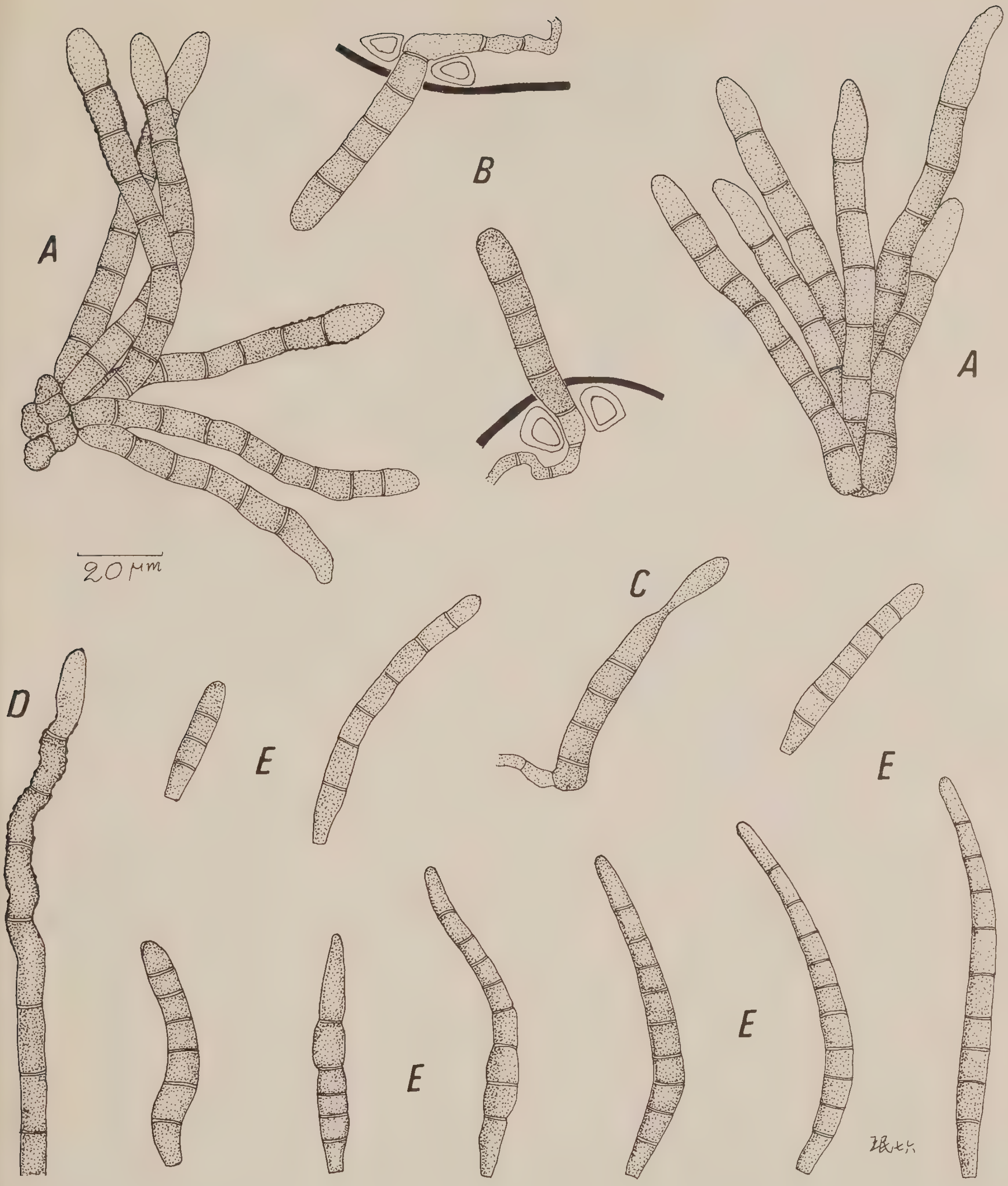

Fig. 6. Pseudocercospora tectonicola: A, Fascicles of conidiophores; B, Solitary conidiophores; C, Formation of conidia; D, Above part of old conidiophores; E, Conidia.

idiis obclavato-cylindraceis, pallide olivaceis, rectis vel leniter curvatis, 1-6 septatis (plerumque 3 septatis), apice rotundatis, basi obconico-truncatis, 15-65 x 2-4 µm.

Habitat in foliis vivis *Viticis negundo* L. (Verbenaceae), ad Duttapukur, 24-Parganas, Bengal occidentalis, India, leg. B.K. Das, 1 III 1980, No. PCC 4256 (IMI 250374) (Herb. LAM Yen #10600, holotypus).

Leaf spot rather distinct, dark-brown, more visible on upper surface, suborbicular, angular or irregular, scattered, 1-3 mm in diameter, sometimes up to 4 mm long. Caespituli hypogenous, invisible even under the hand lens. Primary mycelium internal: hyphae subhyaline or very pale olivaceous, smooth, septate, branched, 1.5-3.5 µm wide. Stromata black-brown, irregularly globular, 24-40 µm in diameter. Conidiophores strictly hypophyllous, numerous in dense fascicles, pale olivaceous and paler towards the tip, simple, 0-3 septate, 0-2 geniculate, often tortuous, sometimes denticulate above, apex attenuate or irregularly rounded, conidial scars sometimes visible, 15-43 x 3-4 (-5) µm. Secondary mycelium superficial: hyphae arising from stomata or from stromata and mixed with the primary conidiophores, pale olivaceous, septate, branched, smooth, 2.5-3 µm wide, bearing secondary conidiophores as lateral branches. Conidia obclavate-cylindric, pale olivaceous, straight or slightly curved, 1-6 septate but generally 3 septate, apex rounded, smooth, not constricted, base obconically truncate, 15-65 x 2-4 µm.

On *Vitex negundo* L. (Verbenaceae), in Duttapukur, 24-Parganas, West Bengal, India, leg. B.K. Das, 1 III 1980, No. PCC 4256 (IMI 250374) (Herb. LAM Yen #10600).

Note: *Cercospora viticis* Ell. & Ev., *C. weberi* Chupp and *C. agawalii* Chupp apud Agarwal & Hasija differ from our fungus by their strictly epigenous fruiting. On the other hand, *Pseudocercospora viticicola* (Yen & Lim) Yen and *P. vitici-quinatae* (Yen) Yen are distinct from this species by their always amphiphyllous caespituli.

9. Stenella coffeae Yen, Kar & Das, sp. nov. (Fig. 8)

Maculis irregulariter orbicularis, griseis vel obscure griseis, margine indistinctis, dispersis vel confluentis, 2-4 mm diam. Caespitulis hypophyllis, invisibilis. Mycelium primarium immersum: hyphis olivaceis vel pallide olivaceis, laevis, septatis, ramosis, subtiliter verruculosis, 2.5-4 µm latis. Stromatibus atrobrunneis, subglobosis, 25-50 µm diam. Conidiophoris primariis 2-14 in fasciculo per stomatibus emergentis, brunneis vel profunde brunneis, sursum pallidioris, simplicibus, inferne erectis vel suberectis, superne tortuosis vel denticulatis, laevis, 4-6 septatis, non geniculatis, ad apicem rotundatis et saepe undulatis vel denticulatis et cicatricibus conidialis atrobrunneis ornatis, 65-220 x 4-5 µm. Mycelium secundarium superficiale: hyphis ex stomatibus oriundis, pallide brunneo-olivaceis, laevis, septatis, ramosis, valde verruculosis, 2-3 µm latis, conidiophoris secundariis lateraliter gerentis. Conidiis cylindraceis, brunneis vel pallide brunneo-olivaceis, valde verruculosis, rectis vel leniter curvatis, interdum leniter undulatis, 3-18 septatis, non constrictis, utrimque rotundatis, cellula basali in hilum atrobrunneum, 33-200 x 3-5 (-6) µm.

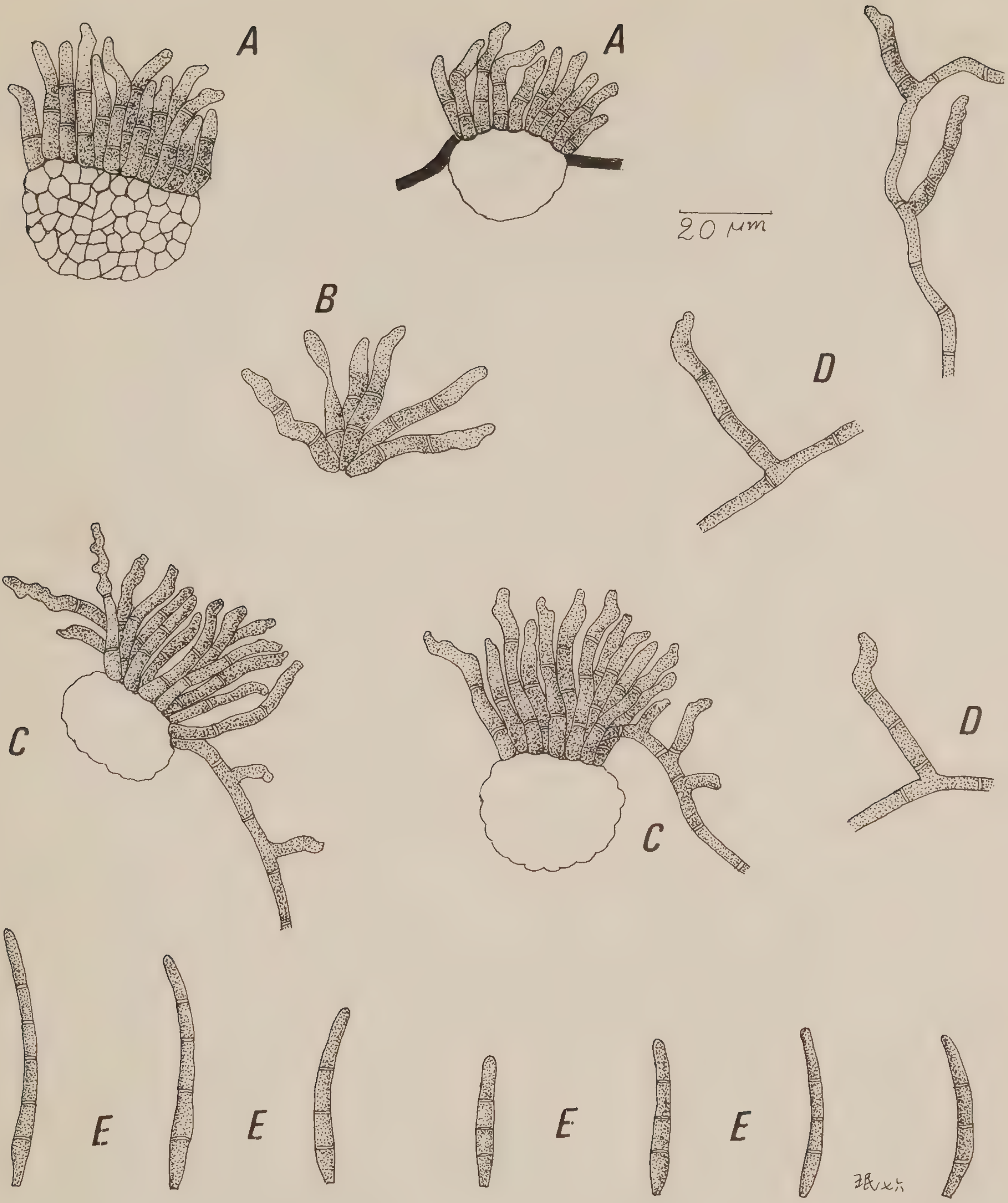

Fig. 7. Pseudocercospora viticigena: A, Conidiophores and stromata; B, Formation of conidia; C, Formation of secondary mycelial hyphae; D, Secondary conidiophores; E, Conidia.

Habitat in foliis vivis *Coffeae bengalensis* Roxb. (Rubiaceae), ad Baraipur, 24-Parganas, Bengal occidentalis, India, leg. B.K. Das, 6 XII 1979, No. PCC 4014 (IMI 246498) (Herb. LAM Yen #10592, holotypus).

Leaf spot blurred, irregularly orbicular, gray to dark gray, without distinct margin, scattered or confluent, 2-4 mm in diameter. Caespituli hypogenous, invisible even under hand lens. Primary mycelium internal: hyphae olivaceous or pale olivaceous, septate, branched, finely verruculose, 2.5-4 µm wide. Stromata dark brown, subglobular, 25-50 µm in diameter. Primary conidiophores 2-14 in fascicles emerging through the stomata, brown to deep brown, paler towards the tip, simple, straight or substraight below, very tortuous above, smooth, 4-16 septate, not geniculate, apex arounded and often undulated or denticulate, decorated with thickened conidial scars on the shoulders, 65-220 x 4-5 µm. Secondary mycelium superficial: hyphae pale brown-olivaceous, arising from the stomata, septate, branched, strongly verruculose, 2-3 µm wide, bearing secondary conidiophores which are much more shorter than the primary conidiophores. Conidia cylindric, brown or pale brown-olivaceous, strongly verruculose, straight or slightly curved, sometimes slightly undulate, 3-18 septate, not constricted, rounded on both ends, decorated with dark-brown cicatrice on the hilum, 33-200 x 3-5 (-6) µm.

On *Coffea bengalensis* Roxb. (Rubiaceae), in Baraipur, 24-Parganas, West Bengal, India, leg. B.K. Das, 6 XII 1979, No. PCC 4014 (IMI 246498) (Herb. LAM Yen #10592).

Note: According to Chupp (1953), Seymour (1967) and Ellis (1976), there are three species of *Cercospora* (*Cercospora coffeicola* Berk. & Cke., *C. herrerana* Farn. and *C. coffeae* Zimm.) which are parasites on the leaves of *Coffea*. But recently, Holliday (1980) considers that *Cercospora herrerana* Farn. and *C. coffeae* Zimm. are just the synonyms of *Cercospora coffeicola* Berk. & Cke. The last species differs from our fungus by its smooth and hyaline conidia.

10. Stenella garugae Yen, Kar & Das, sp. nov. (Fig. 9)

Maculis indistinctis. Caespitulis districte hypophyllis, effusis, angularis et nervuli limitatis, atro-olivaceis, in maculo parvis, dispersis, 0.5-2 mm diam., interdum confluentis. Mycelium primarium immersum: hyphis pallidissime olivaceis, laevis, septatis, ramosis, 1-2.5 µm latis. Stromatibus nullis. Conidiophoris primariis hypophyllis, 2-8 in fasciculo per stomatibus emergentis, divergentis, olivaceis vel pallide olivaceis, sursum pallidioris, laevis, simplicibus vel ramosis, inferne erectis, superne leniter flexuosis, 0-3 septatis, 0-2 geniculatis, ad apicem flectis et attenuatis, cicatricibus conidialis raro visibilis, 12-45 x 4-5 µm. Mycelium secundarium superficiale: hyphis ex stomatibus vel ex conidiophoris primariis oriundis, pallide olivaceis, septatis, ramosis, subtiliter verruculosis, 1.5-4 µm latis, conidiophoris secondariis lateraliter gerentis. Conidiis obclavato-cylindraceis, pallide olivaceis, rectis vel leniter curvatis, subtiliter verruculosis, non constrictis, 3-9 septatis, apice rotundatis vel subobtusis, basi obconicis et attenuato-truncatis, 32-90 x 3-4 µm.

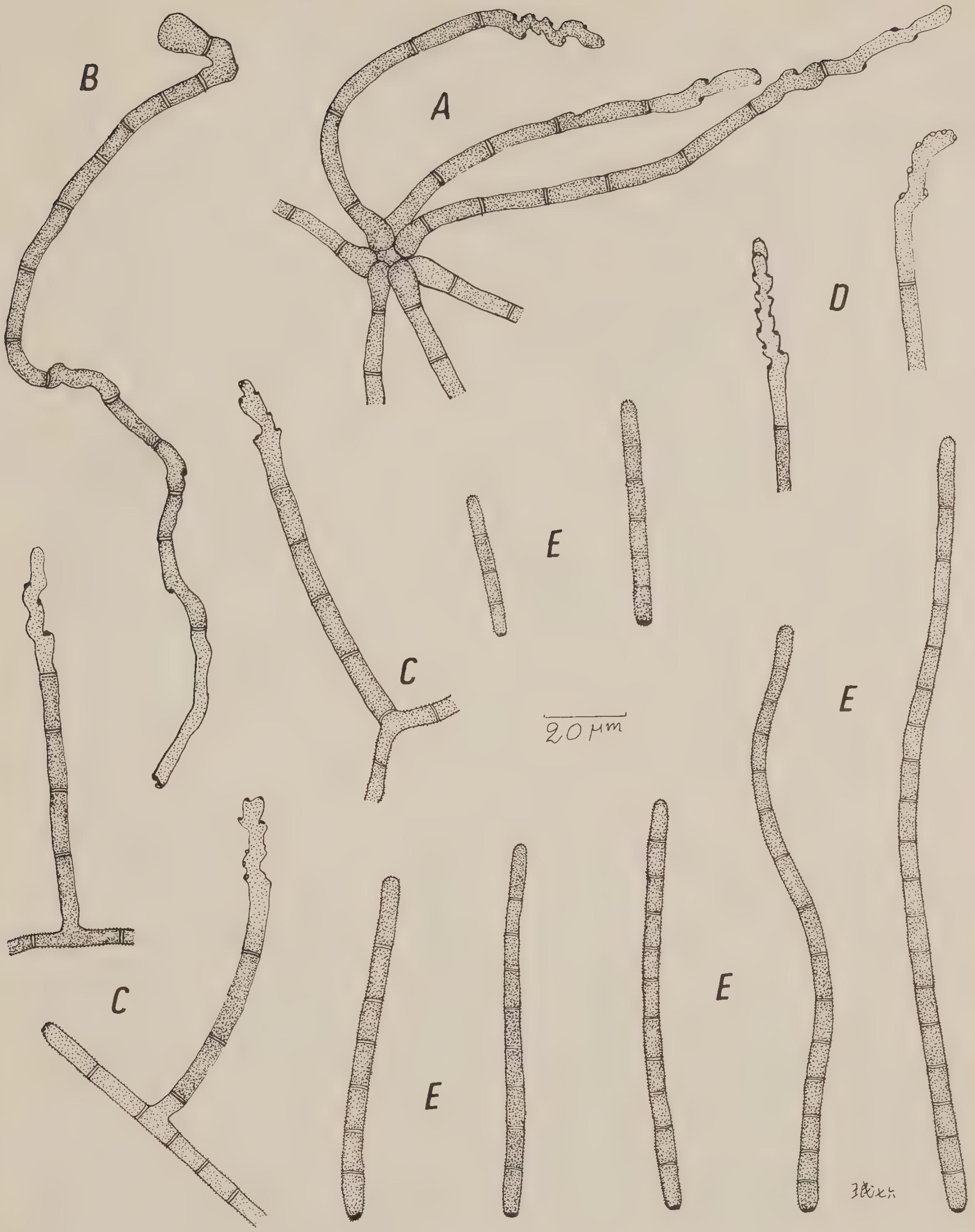

Fig. 8. Stenella coffeae: A, Fascicles of conidiophores; B, Old conidiophores; C, Secondary conidiophores; D, Above part of conidiophores; E, Conidia.

Habitat in foliis vivis *Gargugae pinnatae* Roxb. (Burseraceae), ad Simurali, Nadia, Bengal occidentalis, India, leg. B.K. Das, 4 XII 1980, No. PCC 4462 (Herb. LAM Yen #10602, holotypus).

Leaf spot indistinct or none. Caespituli always hypophyllous, forming olivaceous to dark olivaceous angular small blotches on lower surface, clearly vein-limited, effuse, scattered, 0.5-2 mm in diameter, sometimes confluent. Primary mycelium internal: hyphae very pale olivaceous, smooth, septate, branched, 1-2.5 µm wide. Stromata absent. Conidiophores 2-8 in fascicles emerging through the stomata, but at the same time secondary conidiophores arising abundantly from secondary mycelial hyphae as lateral branches, both kinds of conidiophores similar to each other, olivaceous or mid to pale olivaceous and paler towards the tip, generally simple, rarely once branched, straight below and slightly flexuous above, 0-3 septate, 0-2 geniculate, apex often shouldered and attenuate-truncate, conidial scars sometimes distinct, 12-45 x 4-5 µm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the stomata or from the prolongation of primary conidiophores, septate, branched, very finely verruculose, 1.5-4 µm wide, bearing abundant secondary conidiophores as lateral branches. Conidia obclavate-cylindric, pale olivaceous, straight or very slightly curved, very finely verruculose, 3-9 septate, apex rounded or subobtuse, base obconic and attenuate-truncate, 32-90 x 3-4 µm.
On *Gargua pinnata* Roxb. (Burseraceae), in Simurali, Nadia, West Bengal, India, leg. B.K. Das, 4 XII 1980, No. PCC 4462 (Herb. LAM Yen #10602).

11. Stenella oroxylicola Yen, Kar & Das, sp. nov. (Fig. 10)

Maculis indistinctis, tantum area parva brunnea, margine indistinctis, leniter nervuli limitatis, angularis, dispersis, 2-5 mm diam., interdum confluentis, in superiore superficie plus distinctis. Caespitulis hypophyllis, effusis, in inferiore superficie griseis. Mycelium immersum: hyphis pallidissime olivaceis, laevis, septatis, ramosis, 2-5 µm latis. Stromatibus nullis. Conidiophoris 2-8 in fasciculo per stomatibus emergentis, brunneo-olivaceis, sursum pallidioris, plerumque simplicibus, raro ramosis, laevis (cum membrana incrassatula), saepe flexuosis, 2-13 septatis, leniter multigeniculatis, ad apicem rotundatis vel flectis, cicatricibus conidialis interdum visibilis, 80-260 x 6-7 µm. Conidiis obclavatis, pallide olivaceis, lenitissime curvatis, subtiliter verruculosis, non constrictis, 3-6 septatis, ad apicem subconicis, basi attenuato-truncatis, 40-105 x 5-6 µm.
Habitat in foliis vivis *Oroxyli indici* Vent. (Bignoniaceae), ad Garia, 24-Parganas, Bengal occidentalis, India, leg. B.K. Das, 26 XII 1979, No. PCC 4091 (IMI 256518) (Herb. LAM Yen #10594, holotypus).

Leaf spot indistinct, only some brownish angular discolored small areas without definite margin, slightly vein-limited, more visible on upper surface, scattered, 2-5 mm in diameter, sometimes confluent. Caespituli hypophyllous, effuse, gray, visible on lower surface of the leaf spot. Mycelium internal: hyphae pale olivaceous, smooth, branched, septate, 2-5 µm wide. Stromata absent. Conidiophores 2-8 in fascicles emerging through the stomata, brown-

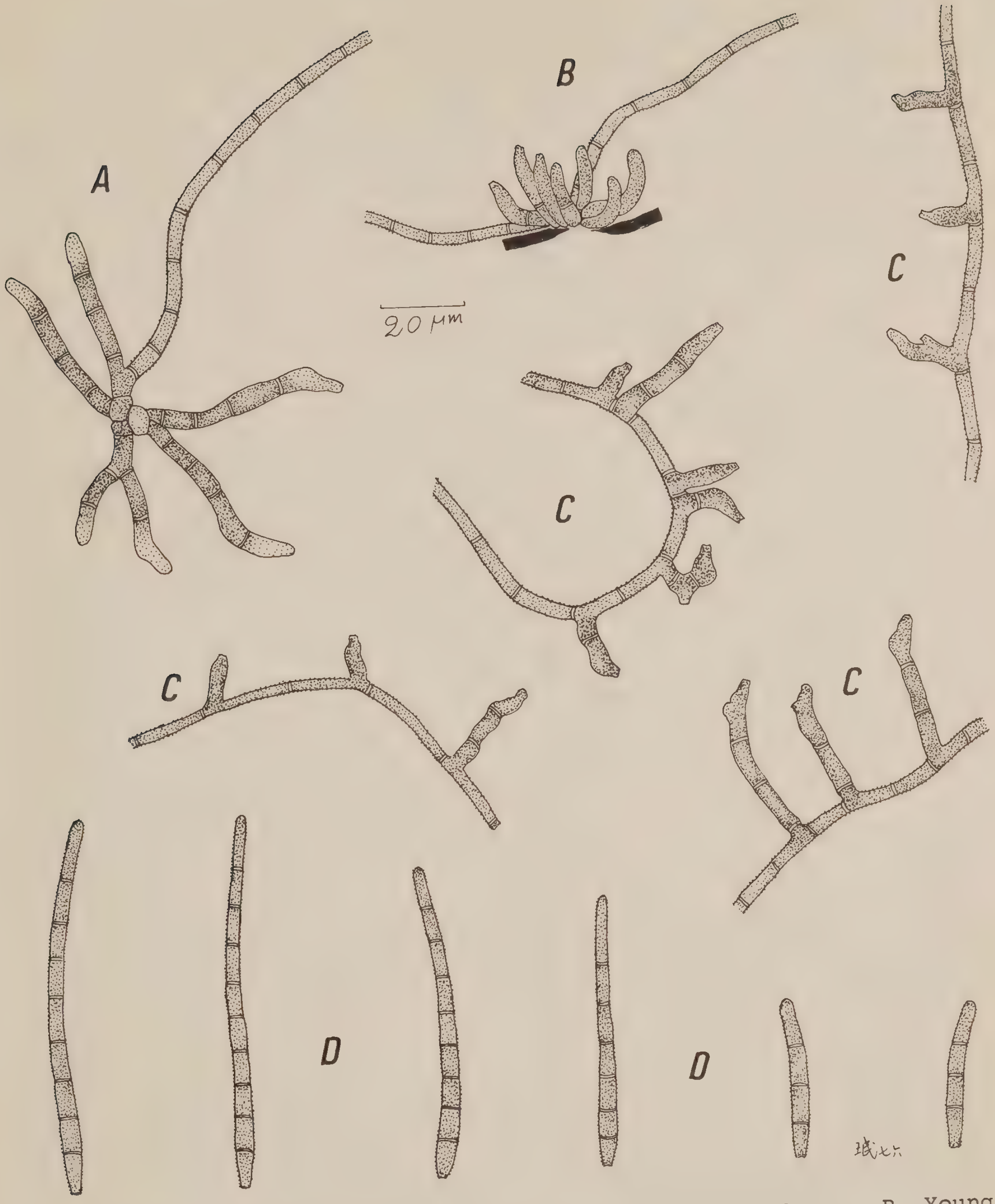

Fig. 9. Stenella garugae: A, Fascicle of conidiophores; B, Young conidiophores and formation of secondary mycelial hyphae; C, Secondary conidiophores; D, Conidia.

olivaceous and paler towards the tip, generally simple, occasionally branched, smooth with rather thick wall, almost flexuous, 2-13 septate, slightly multigeniculate, apex rounded or shouldered and attenuate, conidial scars sometimes visible, 80-260 x 6-7 µm. Conidia obclavate, pale olivaceous, slightly curved, finely verruculose, 3-6 septate, not constricted, apex subconic, base obconic-truncate, 40-105 x 5-6 µm.

On *Oroxylum indicum* Vent. (Bignoniaceae), in Garia, 24-Parganas, West Bengal, India, leg. B.K. Das, 26 XII 1979, No. PCC 4091 (IMI 256518) (Herb. LAM Yen #10594).

12. Stenella xeromphigena Yen, Kar & Das, sp. nov. (Fig. 11)

Maculis distinctis, plerumque orbicularis, in epiphyllo albo-griseis, in hypophyllo pallide brunneis, autem margine linearis subelevatis, dispersis, 3-14 mm diam., interdum confluentis. Caespitulis amphiphyllis, autem principaliter epiphyllis, in superiore superficie obscure punctiformis. Mycelium primarium immersum: hyphis olivaceis, frequentissime subter cuticulis repentis, septatis, ramosis, 2.5-3 µm latis. Stromatibus subter cuticulis positis, atrobrunneis, globosis vel subglobosis, 30-55 µm diam. Conidiophoris primariis 12-42 in fasciculo per scissuris cuticulis emergentis, olivaceis, concoloris, laevis, simplicibus, erectis, cylindraceis, 1-3 septatis, non geniculatis, ad apicem irregulariter rotundatis vel attenuatis, cum cicatricibus conidialis atrobrunneis ornatis, 14-65 x 3-4 µm. Mycelium secundarium superficiale: hyphis olivaceis vel pallide olivaceis, hypophyllis, ex stomatibus oriundis, repentis vel arcuatis, subtiliter verruculosis, septatis, ramosis, 2.5-3.5 µm latis, conidiophoris secundariis lateraliter gerentis. Conidiis cylindraceis vel vermiformis, olivaceis, rectis vel leniter curvatis, interdum undulatis, solitariis vel catenatis, utrimque rotundatis, interdum utrimque cicatricibus atrobrunneis ornatis, plerumque cellulis basali in hilum cicatricibus atrobrunneis ornatis, 20-156 x 3-4 µm.

Habitat in foliis vivis *Xeromphidis uliginosae* (Rubiaceae), ad Sylva Raiganj, Dinajpur occidentalis, Bengal occidentalis, India, leg. B.K. Das, 25 III 1980, No. PCC 4286 (IMI 250390) (Herb. LAM Yen #10593, holotypus).

Leaf spot distinct, generally orbicular, gray-whitish on upper surface, pale brownish on lower surface, but with a linear raised margin on both surfaces, scattered, 3-14 mm in diameter, sometimes confluent. Caespituli amphiphyllous, but chiefly epiphyllous, visible as small dark punctiform on upper surface of the leaf spot. Primary mycelium internal: hyphae olivaceous, often under the cuticle, septate, branched, 2.5-3.5 µm wide. Stromata well developed, generally situated between the cuticle and the epidermal cells, dark-brown, globular or subglobular, 30-55 µm in diameter. Primary conidiophores 12-42 in fascicles emerging through the rupture of cuticle, olivaceous and concolorous, simple, cylindric and straight, 1-3 septate, apex irregularly rounded or attenuate-truncate and decorated with dark-brown conidial scars, 14-65 x 3-4 µm. Secondary mycelium superficial: hyphae olivaceous or pale olivaceous, hypophyllous, abundant, arising from the stomata, repent or arcuate, finely verruculose, branched, septate, 2.5-3.5 µm wide,

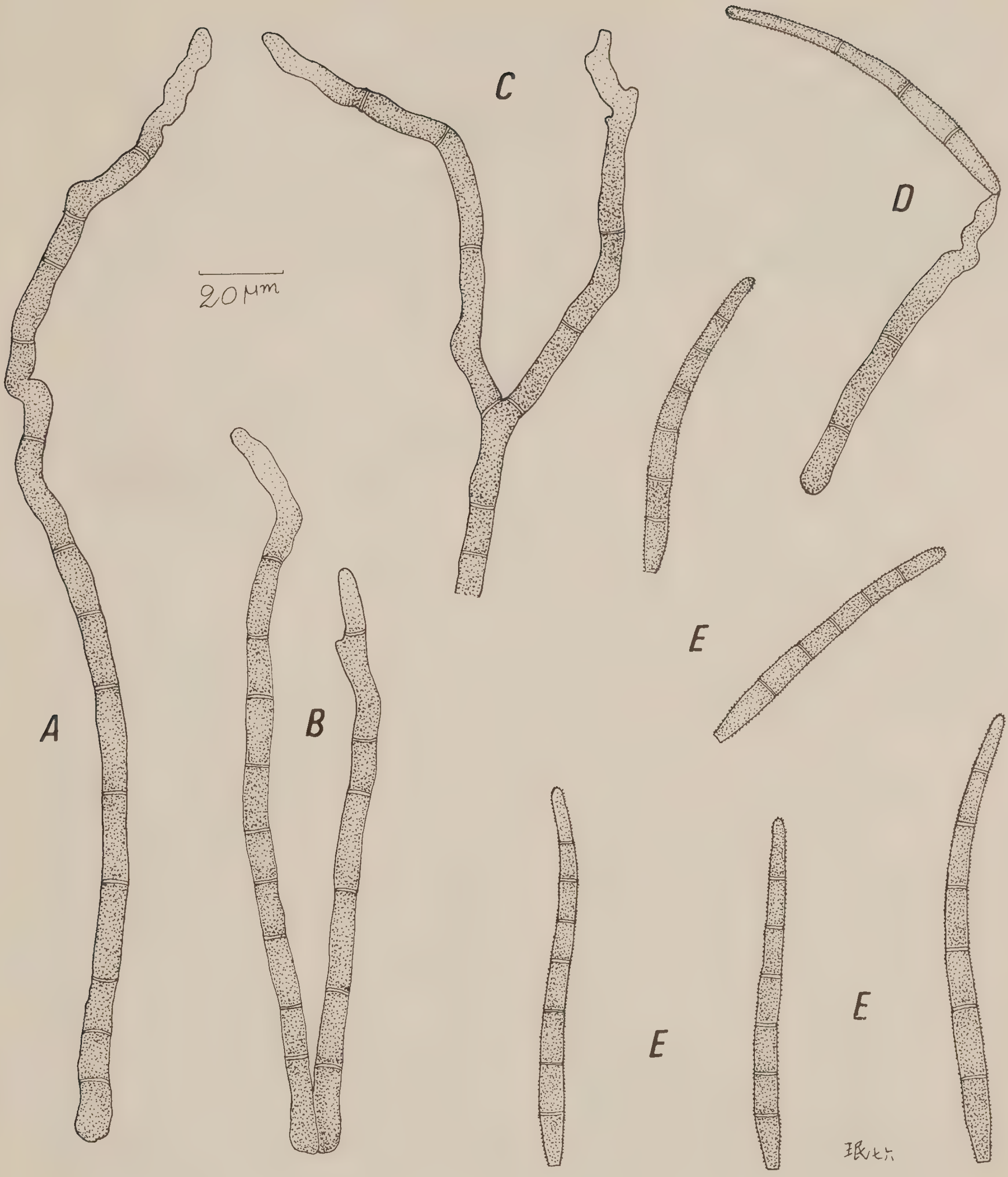

Fig. 10. Stenella oroxylicola:A, Old conidiophores; B, Young conidiophores; C, Branched conidiophores; D, Formation of conidia; E, Conidia.

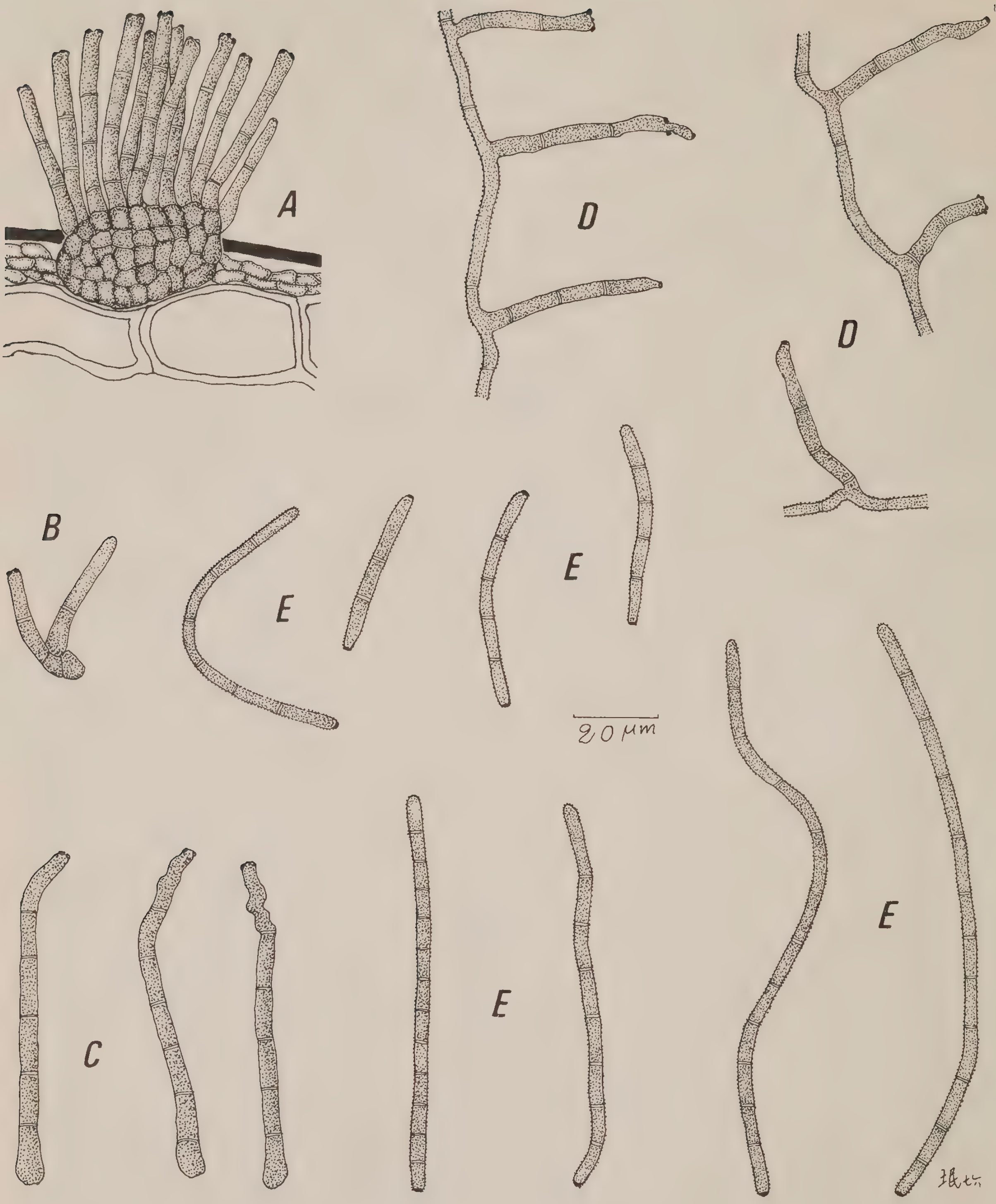

Fig. 11. Stenella xeromphigena: A, Conidiophores and stromata; B, Young conidiophores; C, Old conidiophores; D, Secondary conidiophores; E, Conidia.

bearing secondary conidiophores as lateral branches. Conidia cylindric or narrowly vermiform, olivaceous, straight or curved and undulated, finely verruculose, 1-14 septate, not constricted, solitary or catenate, rounded on both ends, generally decorated with a dark-brown cicatrice on the hilum, but sometimes both ends decorated by two dark-brown cicatrices, 20-156 x 3-4 μm.

On leaves of *Xeromphis uliginosa* (Rubiaceae), in Raigani Forest, West Dinajpur, West Bengal, India, leg. B.K. Das, 25 III 1980, No. PCC 4286 (IMI 250390) (Herb. LAM Yen #10593).

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STUDIES ON HYPHOMYCETES FROM WEST BENGAL, INDIA, III. CERCOSPORA AND ALLIED GENERA OF WEST BENGAL, 3

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ABSTRACT

The third of a series of studies on Hyphomycetes from West Bengal, India, includes descriptions and illustrations of six new species of Indian Cercosporae: *Cercoseptoria caesalpiniae* sp. nov., on *Caesalpinia digyna*; *C. cedrelae* sp. nov., on *Cedrela toona; Phaeoisariopsis caesalpiniae* sp. nov., on *Caesalpinia bonducella; Pseudocercospora meliicola* sp. nov., on *Melia azedarach; Stenella cedrelae* sp. nov., on *Cedrela toona;* and *Stenella cynanchi* sp. nov., on *Cynanchum callitata.*

1. Cercoseptoria caesalpiniae Yen, Kar & Das, sp. nov. (Fig. 1)

Maculis indistinctis. Caespitulis districte hypophyllis, invisibilis. Mycelium immersum: hyphis pallidissime olivaceis vel subhyalinis, laevis, septatis, ramosis, 2.5-5 μm latis, interdum usque ad 7 μm latis, substomatalis. Stromatibus nullis vel valde inchoatis. Conidiophoris hypophyllis, 2-15 in fasciculo per stomatibus emergentis, pallide olivaceis, concoloris, simplicibus vel ramosis, erectis vel leniter flexuosis, 1-6 septatis, 0-1 geniculatis, ad apicem rotundatis, cicatricibus conidialis invisibilis, 30-60 x 4-5 μm. Conidiis cylindraceis, pallide olivaceis, rectis vel leniter curvatis, plerumque 3 septatis, interdum 5 vel 7 septatis, laevis, non constrictis, apice rotundatis, basi truncatis, 35-85 x 3-3.5 μm.

Habitat in foliis vivis *Caesalpiniae digynae* Rottb. (Leguminosae), ad Aranghata, Nadia, Bengal occidentalis, India, leg. B.K. Das, 29 XII 1979, No. PCC 3708 (IMI 237401) (Herb. LAM Yen #10610, holotypus).

Leaf spot indistinct or none. Caespituli strictly hypophyllous, invisible even under the hand lens. Mycelium internal: hyphae very pale olivaceous or subhyaline, smooth, branched, septate, 2.5-5 μm wide, up to 7 μm for that situated beneath the stomata. Stromata lacking or very rudimentary. Conidiophores hypophyllous, 2-15 in fascicles

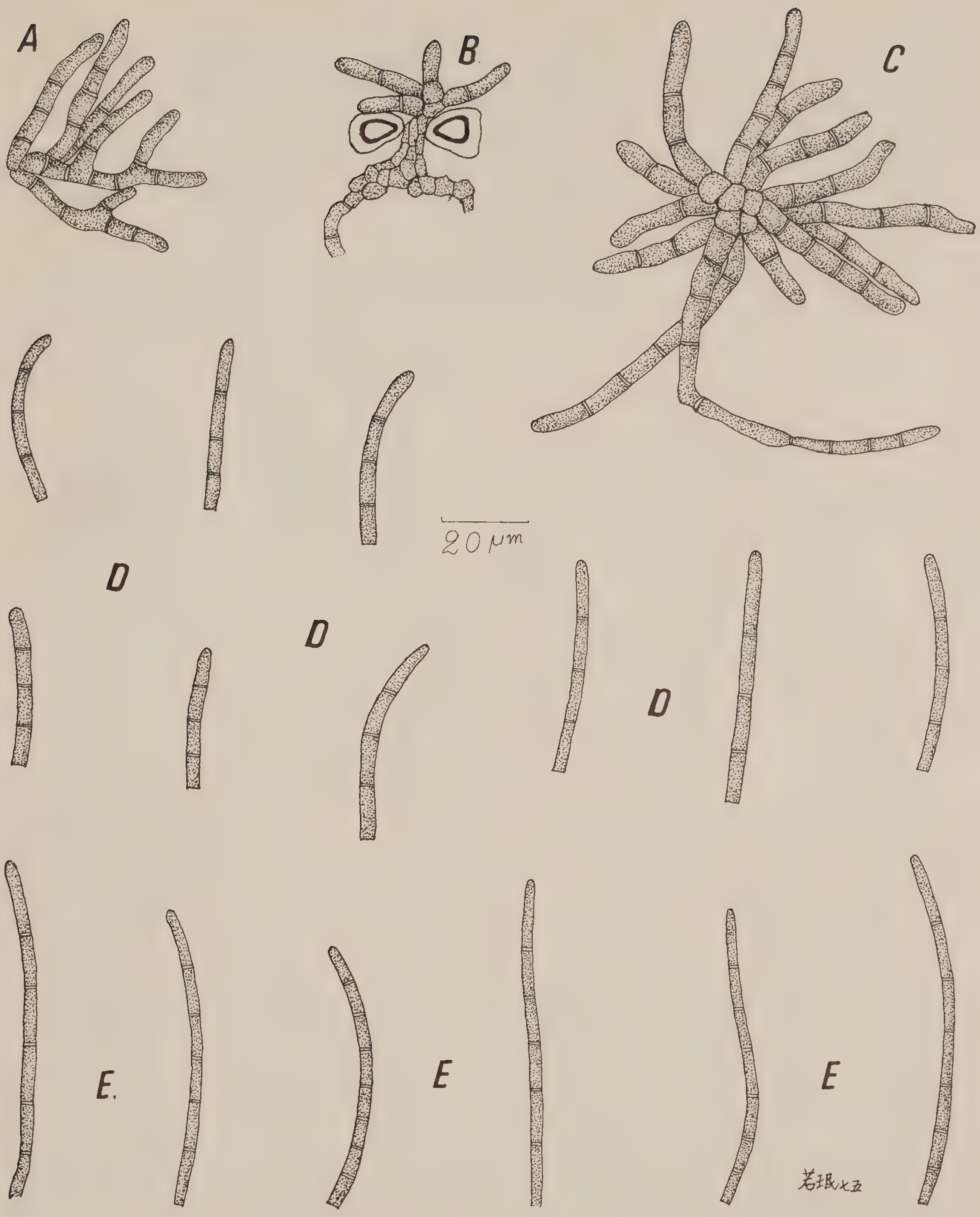

Fig. 1. Cercoseptoria caesalpiniae: A, Branched conidiophores; B, Young conidiophores and rudimentary stromata; C, Formation of conidia; D, 3 septate conidia; E, 5-7 septate conidia.

emerging through the stomata, pale olivaceous, concolorous, simple or branched, straight or slightly flexuous, 1-6 septate, 0-1 geniculate, smooth, apex rounded or attenuate and sometimes slightly swollen, conidial scars indistinct, 30-60 x 4-5 µm. Conidia cylindric, pale olivaceous, straight or slightly curved, generally 3 septate (sometimes 5 or 7 septate), smooth, not constricted, apex rounded, base truncate, 35-85 x 3-3.5 µm.

On living leaves of *Caesalpinia digyna* Rottb. (Leguminosae), in Aranghata, Nadia, West Bengal, India, leg. B.K. Das, 29 XII 1979, No. PCC 3708 (IMI 237401) (Herb. LAM Yen #10610).

2. Cercoseptoria cedrelae Yen, Kar & Das, sp. nov. (Fig. 2)

Maculis angularis vel irregularis, saepe nervuli limitalis, cum margine aliquantum distinctis, primo lucido-brunneis, dein in epiphyllo albo-griseis et in hypophyllo obscure brunneis, dispersis, interdum confluentis, 1-8 mm diam. Caespitulis amphigenis, autem principaliter hypophyllis, atro-punctiformis. Mycelium primarium immersum: hyphis pallidissime olivaceis, laevis, septatis, ramosis, 2-2.5 µm latis. Stromatibus atro-brunneis, globosis vel subglobosis, saepe intra cellulis epidermicis, 20-30 µm diam. Conidiophoris 5-32 in fasciculo per scissuris cellulis epidermicis emergentis, pallide olivaceis vel olivaceis, concoloris, simplicibus, laevis, 0-1 septatis, 0-1 geniculatis, cicatricibus conidialis indistinctis, ad apicem irregulariter rotundatis, 14-35 x 3.5-4.5 µm. Mycelium secundarium superficiale: hyphis pallide olivaceis, ex stomatibus oriundis, laevis, septatis, ramosis, 2-3 µm latis, conidiophoris secundariis lateraliter manifestibus. Conidiis filiformis, pallidissime olivaceis, leniter curvatis, plerumque 5 septatis (raro 2 vel 6 septatis), laevis, non constrictis, apice obtusis, basi truncatis, 50-80 x 2-2.5 µm.

Habitat in foliis vivis *Cedredae toonae* Roxb. (Meliaceae), ad Raiganj, Dinajpur occidentalis, Bengal occidentalis, India, leg. B.K. Das, 7 X 1980, No. PCC 4415a (Herb. Lam Yen #10608, holotypus).

Leaf spot distinct, angular or irregular, often vein-limited, with margin rather distinct, at first brownish, becoming later to white-grayish on upper surface and dull brown on lower surface, scattered or confluent, 1-8 mm in diameter. Caespituli amphigenous, but chiefly hypophyllous, black punctiform. Primary mycelium internal: hyphae pale olivaceous, smooth, branched, septate, 2-2.5 µm wide. Stromata globular or subglobular, dark brown, often situated in the epidermal cells, 20-30 µm in diameter. Conidiophores 5-32 in fascicles emerging through the rupture of the epidermal cells, pale olivaceous to mid olivaceous, concolorous, simple, smooth, 0-1 (rarely 2) septate, 0-1 geniculate, conidial scars not visible, apex irregularly rounded (sometimes shouldered), 14-35 x 3.5-4 µm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the stomata, smooth, branched, septate, 2-3 µm wide, bearing secondary conidiophores as lateral branches. Conidia very pale olivaceous, filiform, slightly curved, generally 5 septate (rarely 6 septate), smooth, not constricted, apex obtuse, base truncate, 2-2.5 µm wide and 50-80 µm long.

On living leaves of *Cedrela toona* Roxb. (Meliaceae), in

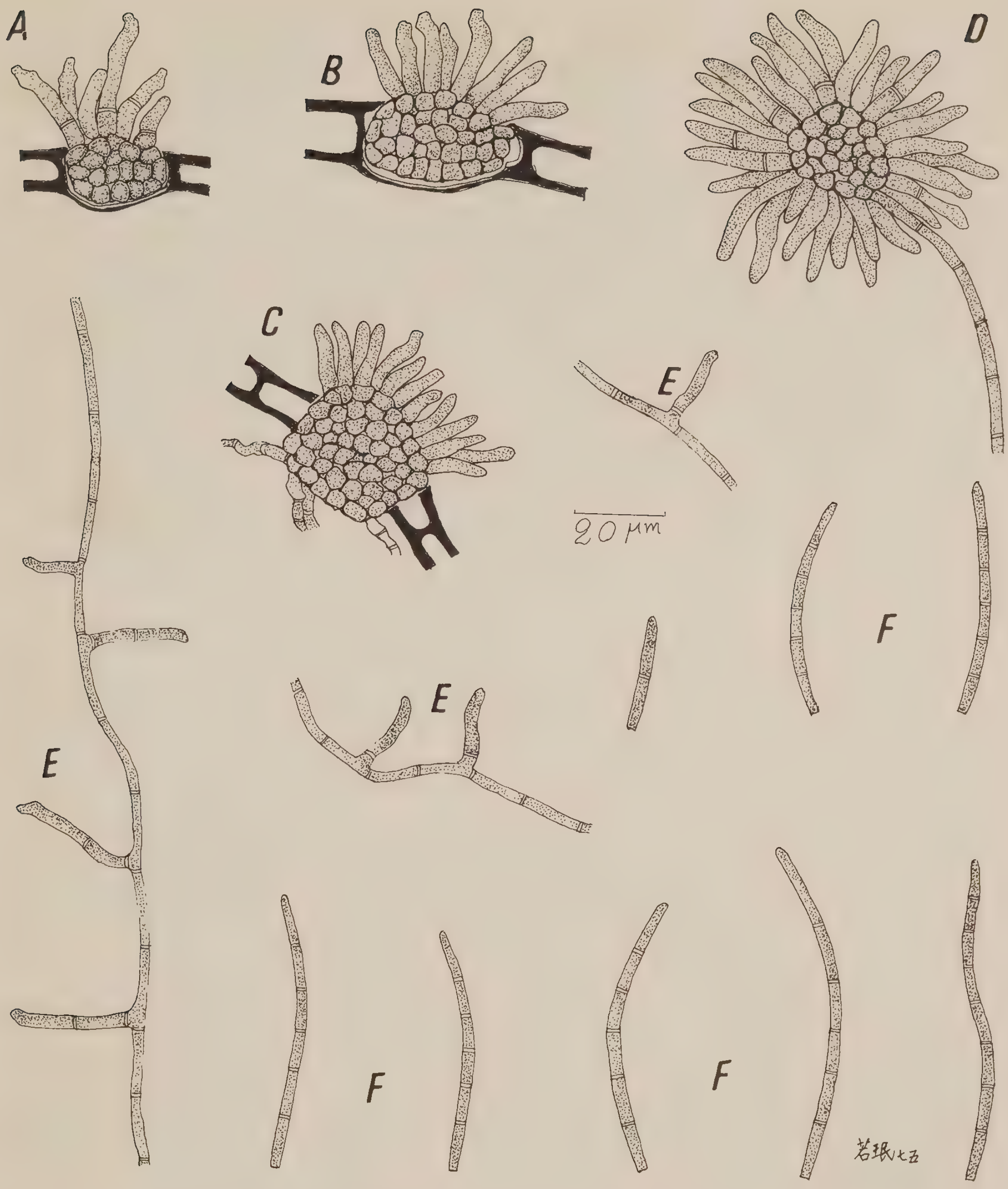

Fig. 2. Cercoseptoria cedrelae: A, Old conidiophores and stromata; B & C, Young conidiophores and stromata; D, Formation of secondary mycelial hyphae; E, Secondary conidiophores; F, Conidia.

Raiganj, West Dinajpur, West Bengal, India, leg. B.K. Das, 7 X 1980, No. PCC 4415a (Herb. LAM Yen #10608).

3. Phaeoisariopsis caesalpiniae Yen, Kar & Das, sp. nov. (Fig. 3)

Maculis orbicularis vel suborbicularis, clare brunneis, minusculis, 1-2 mm diam., dispersis, cum marginis atro-linearis et subelevatis circumtextis, raro confluentis. Caespitulis districte hypophyllis, atropunctiformis. Mycelium immersum: hyphis subhyalinis, laevis, ramosis, septatis, 2.5-3.5 µm latis. Stromatibus evolutis, irregulariter globosis, 30-45 µm diam. Conidiophoris hypophyllis, pallide brunneo-olivaceis, sursum pallidioris, laevis, 12-32 in fasciculo synnematiforme aggregatis, multi-septatis, simplicibus, plerumque erectis, ad apicem rotundatis, cicatricibus conidilis distinctis (2-2.5 µm diam.) , 50-215 x 4-6 µm. Conidiis obclavatis vel obclavato-cylindraceis, pallidissime olivaceis, plerumque curvatis, raro rectis, 2-9 septatis, laevis, apice rotundatis, basi obconico-truncatis, 43-105 x 5-6.5 µm.

Habitat in foliis vivis *Caesalpiniae bonducellae* (L.) Flem. (Leguminosae), ad Palpara, Nadia, Bengal occidentalis, India, Leg. B.K. Das, 25 XI 1979, No. PCC 3706 (IMI 237382) (Herb. LAM Yen #10611, holotypus).

Leaf spot distinct, orbicular or suborbicular, bright brown, often bordered with a raised dark linear margin on both two surfaces, scattered or slightly confluent, 1-2 mm in diameter. Caespituli always hypophyllous, in dark punctiform. Mycelium internal: hyphae subhyaline, smooth, septate, branched, 2.5-3.5 µm wide. Stromata well developed, substomatal, irregularly globular, 30-45 µm in diameter. Conidiophores hypophyllous, synnematous, 12-32 in dense synnemata arising from the well developed stromata, olivaceous-brown and paler towards the tip, simple, multiseptate, generally straight, not geniculate, smooth, dark-brown conidial scars visible at the tip of young conidiophores (2-2.5 µm in diameter), apex rounded, 50-215 x 4-6 µm. Conidia obclavate or obclavate-cylindric, very pale olivaceous, generally curved, 2-9 septate, smooth, not constricted, apex rounded, base obconic-truncate, 43-105 x 5-6.5 µm.

On living leaves of *Caesalpinia bonducella* (L.) Flem. (Leguminosae), in Palpara, Nadia, West Bengal, India, leg. B.K. Das, 25 XI 1979, No. PCC 3706 (IMI 237382) (Herb. LAM Yen #10611).

4. *Pseudocercospora kashotoensis* (Yamamoto) Deighton (Fig. 4) CMI Mycological Papers, No. 140:146, 1976.
= *Cercospora kashotoensis* Yamamoto, Trans. Nat. Hist. Soc. Formosa 26:282, 1936.

Leaf spot indistinct or none. Caespituli hypophyllous, slightly effuse, forming pale olivaceous blotches on lower surface, without any boundary. Primary mycelium internal: hyphae very pale olivaceous or subhyaline, smooth, septate, branched, 2-3 µm wide. Stromata none. Conidiophores hypophyllous, 2-7 in loose fascicles emerging through the stomata, brown-olivaceous or pale brown, simple or rarely branched, straight and attenuate when young, flexuous or

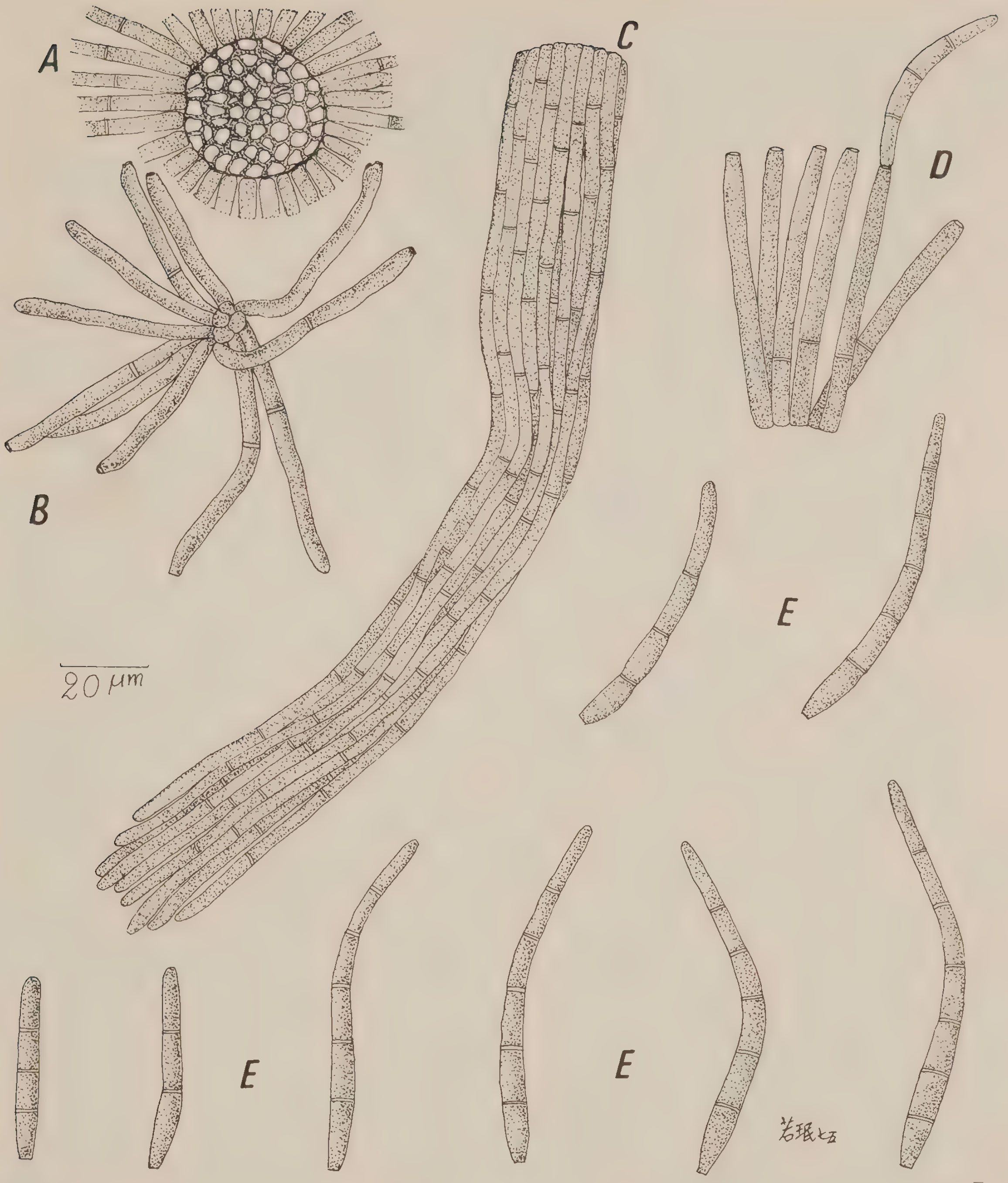

Fig. 3. Phaeoisariopsis caesalpiniae: A, Stromata; B, Young conidiophores: C, Synnemata(caespitose conidiophores); D, Formation of conidia; E, Conidia.

sinuous when old, 1-4 septate, 0-2 geniculate, sometimes forming pseudo-annellations, apex rounded or shouldered, conidial scars scarcely visible but sometimes visible on the shoulders or at the end of short denticles (1.5-2 μm in diameter), 25-75 x 4-6 μm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the stomata, smooth, septate, branched, 2-3 μm wide, bearing secondary conidiophores as lateral branches. Conidia cylindric or obclavate-cylindric, very pale olivaceous, straight or slightly curved, 1-7 septate, apex subacute to subrounded, base attentuate-truncate or obconic-truncate, 25-105 x 3-4.5 μm.

On living leaves of *Clerodendron inerme* (L.) Gaertn. (Verbenaceae), in Andul, Howrah, West Bengal, India, leg. B.K. Das, 20 XII 1979, No. PCC 4082 (IMI 254413) (Herb. LAM Yen #10604).

Note: The *Pseudocercospora clerodendri* (Miyake) Deighton differs from this fungus by its distinct suborbicular to angular leaf spot and especially by its fruiting amphiphyllous or almost epiphyllous.

Distribution: Taiwan (China) and West Bengal (India).

5. Pseudocercospora meliicola Yen, Kar & Das, sp. nov. (Fig. 5)

Maculis distinctis, in epiphyllo plus visibilis, angularis vel irregularis, per nervuli limitatis, in inferiore superficie lucido-brunneis, in superiore superficie albo-brunneis, dispersis vel leniter confluentis, plerumque 1-4 mm diam., interdum usque ad 8 x 4 mm. Caespitulis amphigenis, autem principaliter epiphyllis. Mycelium primarium immersum: hyphis pallide olivaceis, laevis, ramosis, septatis, 2-3 μm latis. Stromatibus atrobrunneis, subglobosis, 25-35 μm diam. Conidiophoris amphiphyllis, numerosis in fasciculo per stomatibus emergentis, pallide brunneo-olivaceis, concoloris, plerumque simplicibus, interdum ramosis, flexuosis, 0-3 septatis, 0-2 geniculatis, laevis, ad apicem rotundatis vel attenuatis, cicatricibus conidialis indistinctis, 15-45 (-50) x 3-4.5 μm. Mycelium secundarium superficiale: hyphis pallide olivaceis, cum conidiophoris primariis commixa in fasciculo per stomatibus emergentis, septatis, ramosis, laevis, 2-3.5 μm latis, conidiophoris secundariis lateraliter gerentis. Conidiis obclavato-cylindraceis, pallide olivaceis, plerumque leniter curvatis, 3-8 (-11) septatis, apice rotundatis vel subobtusis, basi attenuatis vel obconico-truncatis, 28-92 (-120) x 3-4 μm.

Habitat in foliis vivis *Meliae azedarach* L. (Meliaceae), ad Mallickpur, 24-Parganas, Bengal occidentalis, India, leg. B.K. Das, 4 IX 1980, No. PCC 4352 (Herb. LAM Yen #10609, holotypus).

Leaf spot distinct, much more visible on upper surface, angular or irregular, vein-limited, brown-whitish on upper surface and bright brown on lower surface, scattered or slightly confluent, 1-4 mm in diameter, sometimes up to 8 x 4 mm. Caespituli amphigenous, but chiefly epiphyllous. Primary mycelium internal: hyphae pale olivaceous, smooth, branched, septate, 2-3 μm wide. Stromata dark-brown, subglobular, 25-35 μm in diameter. Conidiophores numerous in fascicles emerging through the stomata, pale brown-olivaceous, concolorous, generally simple, sometimes branched, flexuous, 0-3 septate, 0-2 geniculate, smooth, apex rounded or attenuate,

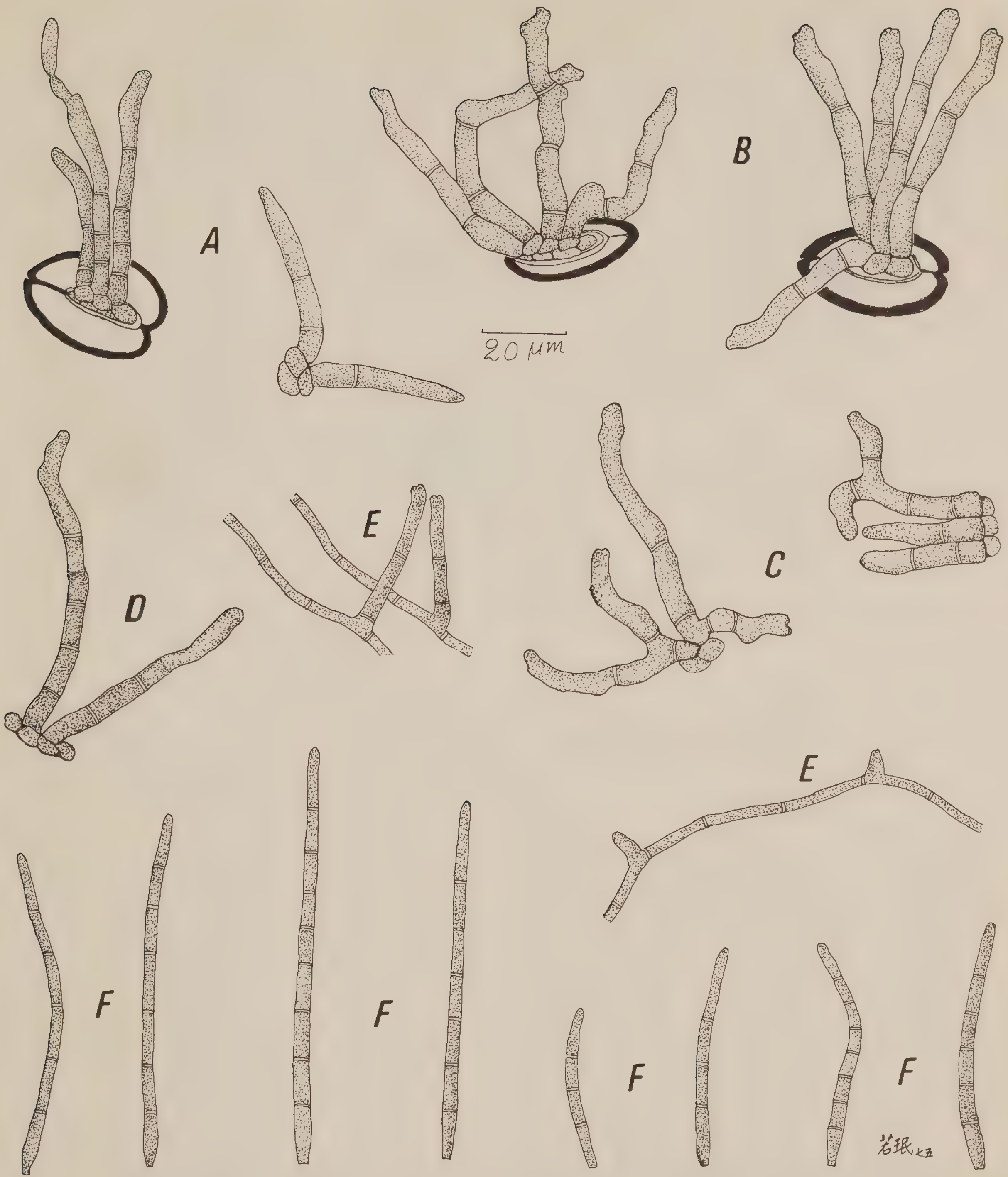

Fig. 4. Pseudocercospora kashotoensis: A, Young conidiophores and formation of conidia; B, Old conidiophores; C, Branched conidiophores; D, Pseudo-annellations; E, Secondary conidiophores; F, Conidia.

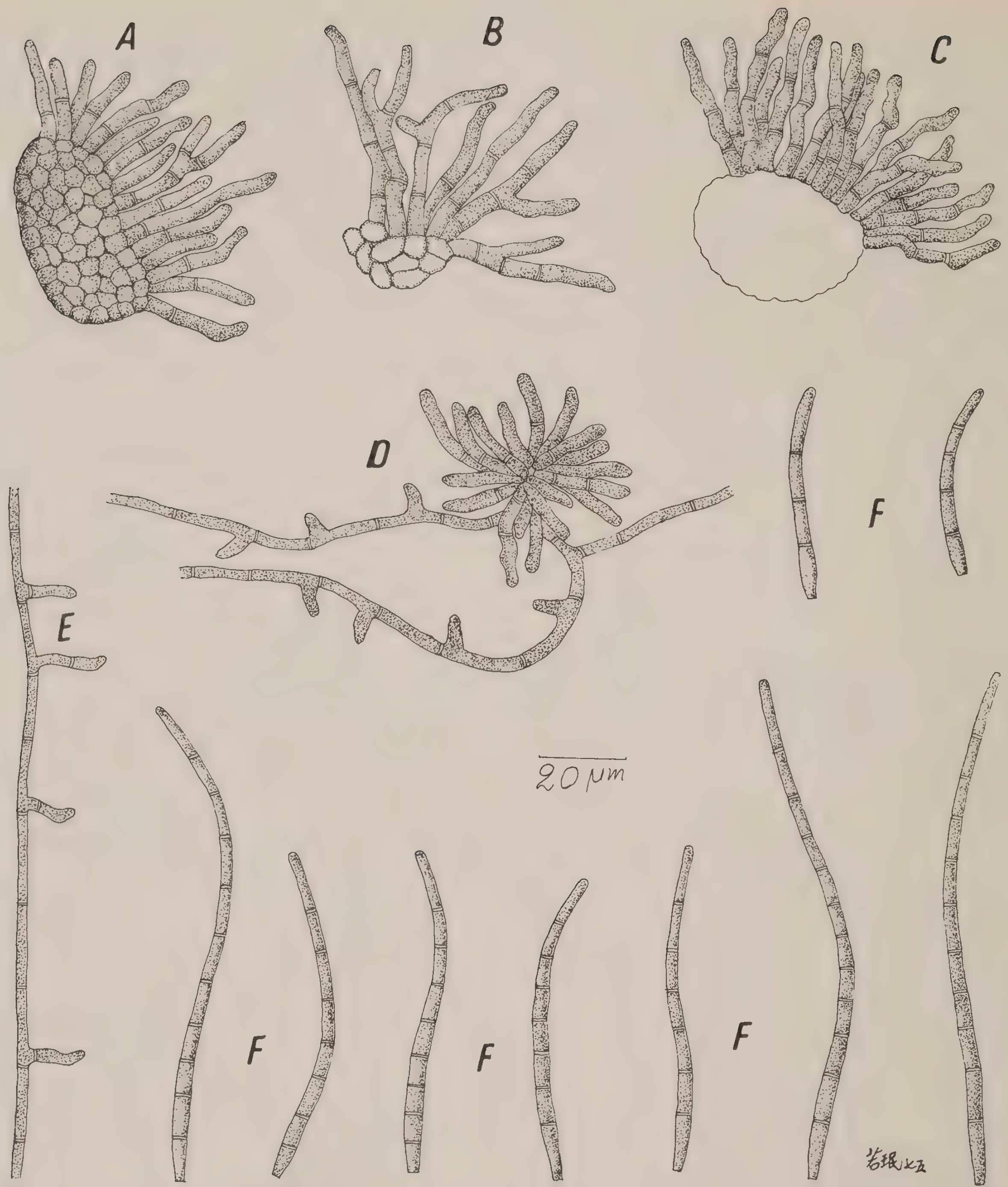

Fig. 5. Pseudocercospora meliicola: A, Stromata and young conidiophores;B, Branched conidiophores; C, Old conidiophores; D, Formation of secondary mycelial hyphae; E,Secondary conidiophores; F, Conidia.

condial scars indistinct, 15-45 (-50) x 3-4.5 µm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the stomata and mixed with the primary conidiophores, septate, branched, smooth, 2-3.5 µm wide, bearing secondary conidiophores as lateral branches. Conidia obclavate-cylindric, pale olivaceous, generally slightly curved, 3-8 (-11) septate, apex rounded or subobtuse, base attenuate or obconically truncate, 28-92 (-120) x 3-4 µm.

On living leaves of *Melia azedarach* L. (Meliaceae), in Mallickpur, 24-Parganas, West Bengal, India, leg. B.K. Das, 4 IX 1980, No. PCC 4352 (Herb. LAM Yen #10609).

Note: The *Pseudocercospora subsessilis* (H. & P. Sydow) Deighton differs from this fungus by its circular and not vein-limited leaf spot, by its hypophyllous caespituli and especially by its conidiophores not septate, not branched and not geniculate.

6. *Pseudocercospora phyllanthi-niruri* (Yen) Yen (Fig. 6, D & E)
Gardens' Bulletin Singapore 33:181, 1980.
= *Cercospora phyllanthi-niruri* Yen, Revue de Mycologie 32: 192, 1967.
Syn. *Cercospora phyllanthicola* Yen, REvue de Mycologie 30: 186, 1965.
non *Cercospora phyllanthicola* Shakil & Kamal, Indian Phytopathology 15:296, 1962.

Leaf spot indistinct or none. Caespituli always hypophyllous, effuse, velutinous, olivaceous-gray, often extending and covering the whole lower surface of the leaf. Mycelium internal: hyphae pale olivaceous, smooth, septate, branched, 2.5-4 µm wide. Stromata lacking. Conidiophores 2-8 in fascicles emerging through the stomata, pale to mid brown-olivaceous, simple and straight when young, flexuous and branched when old, 1-7 septate, 0-2 geniculate, conidial scars rarely visible, apex rounded, 18-110 x 4-6 µm. Conidia obclavate-cylindric but always crescent-shaped, pale olivaceous, 3 septate, apex rounded, base attenuate and obconically truncate, 32-50 x 4.5-6 µm.

On living leaves of *Phyllanthus niruri* L. (Euphorbiaceae), in Simurali, Nadia, West Bengal, India, leg. B.K. Das, 4 XII 1980, No. PCC 4465 (IMI 254415) (Herb. LAM Yen #10606).

Note: This fungus differs from other species on *Phyllanthus* by its conidia always 3 septate and 4.5-6 µm wide.

Distribution: Singapore and India.

7. *Pseudocercospora trematicola* (Yen) Deighton (Fig. 6, A-C)
CMI Mycological Papers 140:154, 1976.
= *Cercospora trematicola* Yen, Bull. Soc. Mycol. Fr. 86: 752, 1970.

Leaf spot indistinct or none. Caespituli generally hypophyllous, effuse, velutinous, forming angular and vein-limited areas, small, dark-gray, scattered, 1-1.5 mm in diameter, sometimes confluent. Mycelium internal: hyphae olivaceous, smooth, septate, branched, 3-5.5 µm wide. Stromata none. Conidiophores 2-15 in fascicles emerging through the stomata, pale olivaceous to mid olivaceous, simple or branched, flexuous or undulated, 3-10 septate, smooth, not geniculate, apex rounded or attenuate, conidial scars indistinct, 30-135 x 4.5-6 µm. Secondary mycelium superficial: hyphae pale olivaceous, arising from the base of the fascicles of primary conidiophores, septate, branched, smooth, 2-3.5 µm wide, bearing numerous secondary conidiophores as lateral branches. Conidia cylindric, pale olivaceous, generally straight, sometimes slightly curved, 3-10 septate, apex rounded, base obconically truncate, 30-130 x 4.5-6 µm.

On living leaves of *Trema orientalis* Bl. (Ulmaceae), in Simurali, Nadia, West Bengal, India, leg. B.K. Das, 4 XII 1980, No. PCC 4464 (IMI 254414) (Herb. LAM Yen #10612).

Distribution: Singapore, Taiwan (China) and India.

8. *Pseudocercospora triumfettae* (H. Sydow) Deighton
CMI Mycological Papers 140:122, 1976.
=*Cercospora triumfettae* H. Sydow, Ann. Mycol. 28:218, 1930.

On living leaves of *Triumfetta rhomboidea* L. (Tilliaceae), in Hemtabad Forest, West Dinajpur, West Bengal, India, leg. B.K. Das, 7 X 1980, No. PCC 4403 (IMI 254403) (Herb. LAM Yen #10605).

Note: We have sent the materials of this fungus to Commonwealth Mycological Institute, Kew, England, and it is identified as *Pseudocercospora triumfettae* (H. Sydow) Deighton. Deighton (1976) has well described and illustrated all the characters of this species.

Distribution: Venezuela, Brazil, Bermuda, Cuba, Rep. Dominica, and India.

9. Stenella cedrelae Yen, Kar & Das, sp. nov. (Fig. 7)

Maculis distinctis, angularis vel irregularis, denique in hypophyllo obscure brunneis, in epiphyllo albo-griseis, dispersis, 1-8 mm diam., interdum confluentis. Caespitulis amphigenis, autem principaliter hypophyllis, atro-punctiformis. Mycelium primarium immersum: hyphis pallide olivaceis, laevis, septatis, ramosis, 2-3 µm latis. Stromatibus nullis. Conidiophoris 2-25 in fasciculo per stomatibus emergentis, simplicibus vel ramosis, pallide olivaceis, concoloris, laevis, flexuosis, 1-3 septatis, 0-2 geniculatis, ad apicem irregulariter rotundatis, cicatricibus conidialis invisibilis, 22-50 x 4-5 µm. Mycelium secundarium superficiale: hyphis pallide olivaceis, subtiliter verruculosis, ex stomatibus oriundis, ramosis, septatis, 2-3.5 µm latis, conidiophoris secundariis lateraliter gerentis. Conidiis obclavatis vel obclavato-cylindraceis, plerumque leniter curvatis, subtiliter verruculosis, non constrictis, 5-15 septatis, apice obtusis vel subrotundatis, basi obconico-truncatis, 42-160 x 3-4.5 µm.

Habitat in foliis vivis *Cedrelae toonae* Roxb. (Meliaceae), ad Raiganj, Dinajpur occidentalis, Bengal occidentalis, India, leg. B.K. Das, 7 X 1980, No. PCC 4415 (Herb. LAM Yen #10608, holotypus).

Leaf spot distinct, angular or irregular, often vein-limited, margin rather distinct, at first small and bright brown, then becoming dull brown on lower surface and whitish-gray on upper surface, scattered, sometimes confluent, 1-8 mm in diameter. Caespituli amphigenous, but chiefly hypophyllous, in black punctiform. Primary mycelium internal: hyphae pale olivaceous, branched, septate, smooth, 2-3 µm wide. Stromata none. Primary conidiophores 2-25 in fascicl

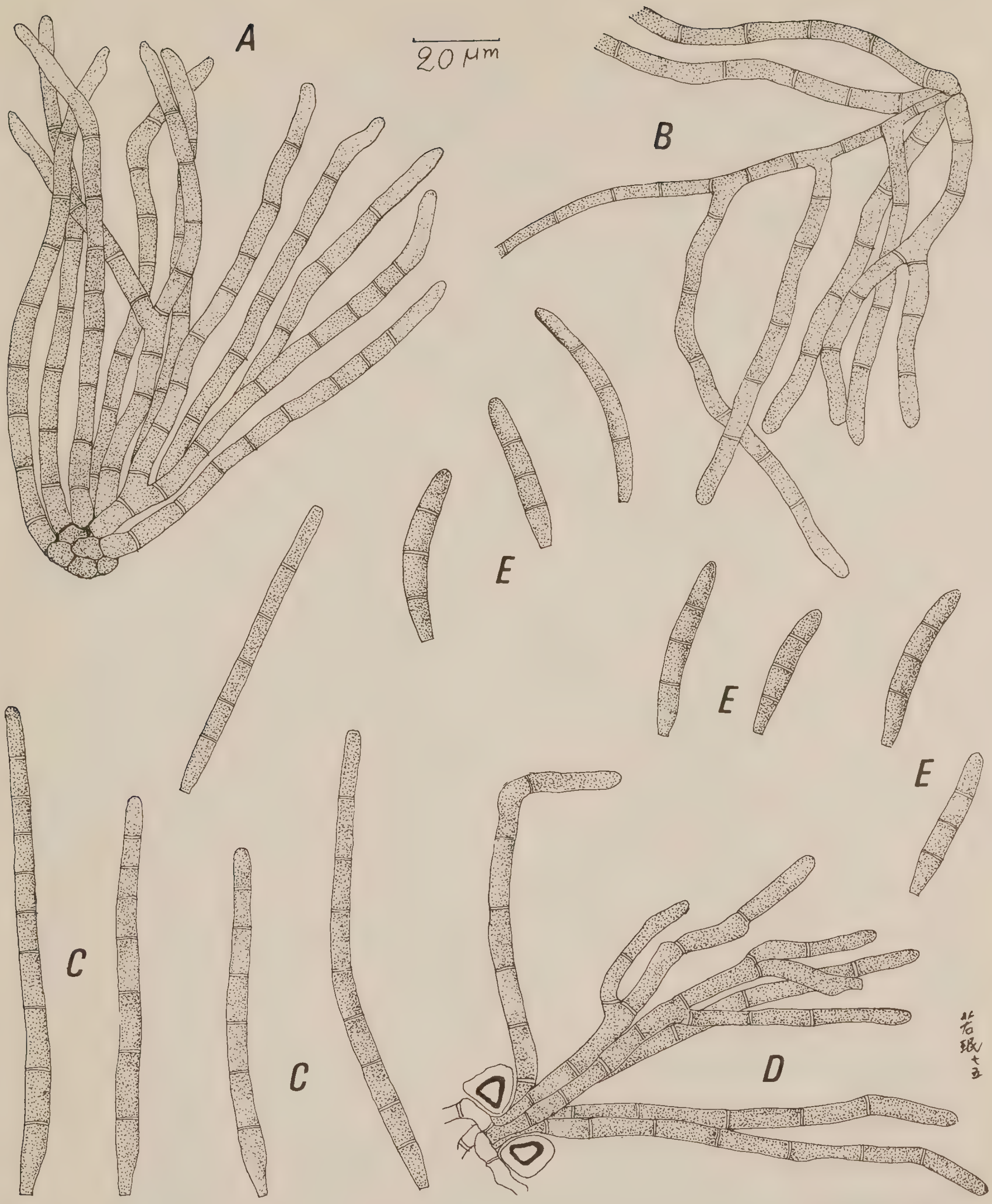

Fig. 6. Pseudocercospora phyllanthi-niruri (D & E): D, Conidiophores; E, Conidia. ---- Pseudocercospora trematicola (A-C): A, Conidiophores; B, Secondary mycelial hyphae and secondary conidiophores; C, Conidia.

emerging through the stomata, pale olivaceous, concolorous, simple or branched, smooth, flexuous, 1-3 septate, 0-2 geniculate, apex irregularly rounded or shouldered, conidial scars not visible, 22-50 x 4-5 μm. Secondary mycelium superficial: hyphae pale olivaceous, finely verruculose, arising from the stomata, branched, septate, 2-3.5 μm wide, bearing abundant secondary conidiophores as lateral branches. Conidia obclavate to obclavate-cylindric, generally slightly curved, finely verruculose, not constricted, 5-14 septate, apex obtuse or subrounded, base obconic-truncate, 42-160 x 3-4.5 μm.

On living leaves of *Cedrela toona* Roxb. (Meliaceae), in Raiganj, West Dinajpur, West Bengal, India, leg. B.K. Das, 7 X 1980, No. PCC 4415 (Herb. LAM Yen #10608).

10. Stenella cynanchi Yen, Kar & Das, sp. nov. (Fig. 8)

Maculis indistinctis. Caespitulis hypophyllis, effusis, velutinis, griseo-olivaceis, in inferiore superficie saepe fere totam folii paginam omnino obtengentis. Mycelium primarium immersum: hyphis olivaceis, subtiliter verruculosis, ramosis, septatis, 2-4 μm latis. Stromatibus nullis. Conidiophoris semper ex mycelium secundarium oriundis, simplicibus, pallide brunneo-olivaceis vel obscure brunneo-olivaceis, inferne plerumque erectis et superne leniter flexuosis vel denticulatis, 1-7 septatis, non geniculatis, laevis, apex attenuatis vel denticulatis et cicatricibus conidialis atro-brunneis decoratis, 15-135 x 3-3.5 μm. Mycelium secundarium superficiale: hyphis pallide olivaceis vel medio-olivaceis, ex stomatibus oriundis, acute verruculosis vel echinulatis, septatis, ramosis, 1.5-2 μm latis, conidiophoris secundariis numerosis lateraliter manifestibus. Conidiis cylindraceis vel fusiformis, pallide olivaceis, solitariis vel catenulatis, rectis, subtiliter verruculosis, 0-1 septatis, apice rotundatis, basi semitruncatis et cicatricibus conidialis atro-brunneis decoratis, interdum utrimque cicatricibus atro-brunneis ornatis, 7-23 x 2.5-3.5 μm.

Habitat in foliis vivis *Cynanchi calliatatae* Ham. (Asclepiadaceae), ad Sylva Joyanti, Alipurduar, Jalpaiguri, Bengal occidentalis, India, leg. B.K. Das, 21 X 1980, No. PCC 4424 (Herb. LAM Yen #10613, holotypus).

Leaf spot indistinct or none. Caespituli hypophyllous, effuse, velutinous, gray olivaceous, extending and covering the whole lower surface of the leaf. Primary mycelium internal: hyphae olivaceous, finely verruculose, branched, septate, 2-4 μm wide. Stromata lacking. Conidiophores always arising from the secondary mycelial hyphae as lateral branches, solitary, simple, pale brown-olivaceous to dark brown-olivaceous, generally straight below and slightly flexuous and denticulate above, 1-7 septate, not geniculate, smooth, apex attenuate or denticulate and decorated with numerous dark-brown conidial scars, 15-135 x 3-3.5 μm. Secondary mycelium superficial: hyphae pale olivaceous to mid olivaceous, arising from the stomata, branched, septate, sharply verruculose or echinulate, 1.5-2 μm wide, bearing numerous secondary conidiophores as lateral branches. Conidia cylindric or fusiform, pale olivaceous, solitary or catenate, straight, finely verruculose, 0-1 septate, apex rounded, base semitruncate and decorated with a dark-brown

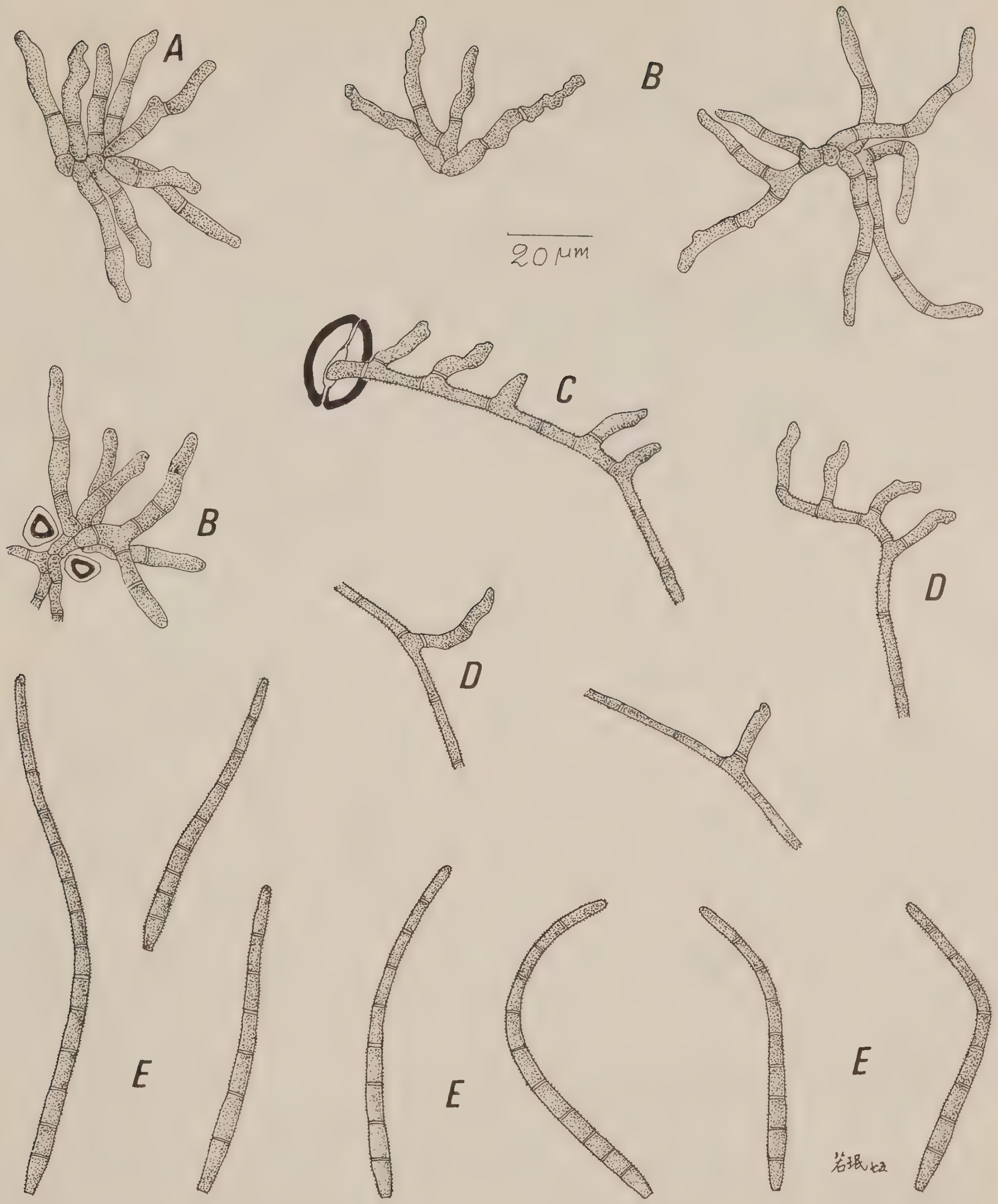

Fig. 7. Stenella cedrelae: A, Young conidiophores; B, Old and branched conidiophores; C, Secondary mycelial hyphae and secondary conidiophores; D, Secondary conidiophores; E, Conidia.

conidial scar, sometimes both two ends decorated with dark-brown conidial scars, 7-23 x 2.5-3.5 µm.

On living leaves of *Cynanchum callitata* Ham. (Asclepiadaceae), in Joyanti Forest, Alipurduar, Jalpaiguri, West Bengal, India, Leg. B.K. Das, 21 X 1980, No. PCC 4424 (Herb. LAM Yen #10613).

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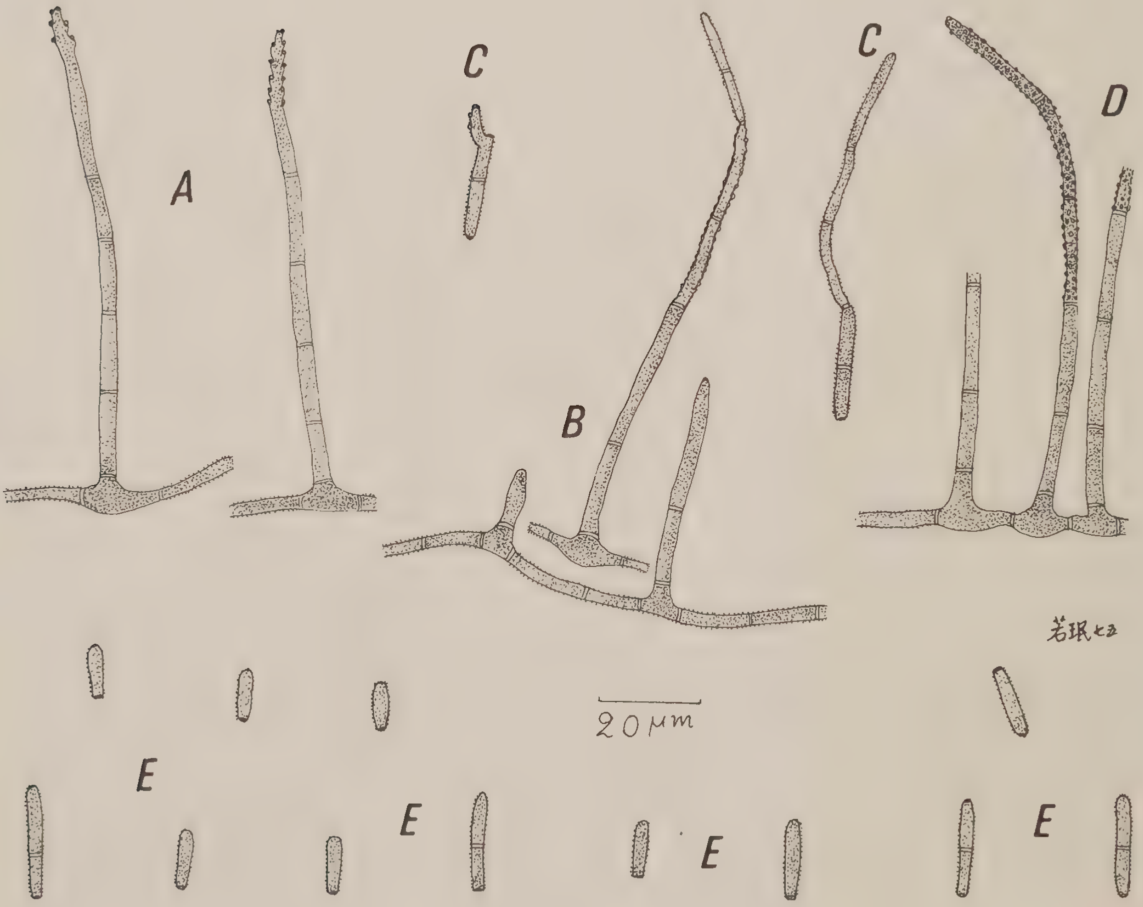

Fig. 8. Stenella cynanchi: A, Old conidiophores; B, Young conidiophores and formation of conidia; C, Germination of conidia; D, Above part of old conidiophores; E, Conidia.

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STUDIES ON PARASITIC FUNGI FROM SOUTH EAST ASIA, 45. PARASITIC FUNGI FROM MALAYSIA, 22.

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Abstract

A new species, Stenella bougainvilleae Yen & Lim is described and illustrated from type material on its host, Bougainvillea spectabilis Willd., collected in Singapore. A new combination, Cercoseptoria cordiicola Yen) Yen, is mentioned.

Stenella bougainvilleae Yen & Lim, sp. nov.

Maculis distinctis, brunneis, orbicularis vel irregulariter orbicularis, margine atro-brunneis circumtextibus, dispersis, 1-7mm diam. saepe confluentibus. Caespitulis hypophyllis, invisibilis. Mycelium primarium immersum: hyphae pallidissime brunneo-olivaceis, septatis, ramosis, 1.5-2.5μm latis. Stromatibus non evolutis. Conidiophoris primariis hypophyllis, 2-8 in fasciculo per stomatibus emergentis, simplicibus, raro ramosis, inferne erectis, antice attenuatis et denticulatis, pallide brunneo-olivaceis, sursum pallidioribus, 3-8 septatis, 0-3 geniculatis, apicibus angustioribus et cicatricibus sporarum atro-brunneis ornatis, 30-90 x 3-4μm. Mycelium secundarium superficiale: hyphis cum conidiophoris primariis commixa in fasiculo per stomatibus emergentis, pallide olivaceis, repentis, septatis, ramosis, subtiliter verruculosis, 2-3μm latis, conidiophoris secundaris lateraliter gerentis. Conidiis cylindriaceis vel subcylindraceis, pallide brunneo-olivaceis, minutissime verruculosis, rectis vel leniter curvatis, plerumque 3-6 septatis (raro 1-2 septatis), non constrictis, ad apicem rotundatis, inferne lenitissime attenuatis, cellula basali in hilum semitruncatum et atrobrunneum, 20-65 x 2.5 - 4μm. Habitat in foliis vivis Bougainvilleae spectabilis (Nyctaginaceae). G. Lim, IV 1980, No. SU 95 (Herb. LAM, YEN #10586), typus.

Leaf spot distinct, brown, orbicular or irregularly orbicular, surrounded by a definite dark brown margin,

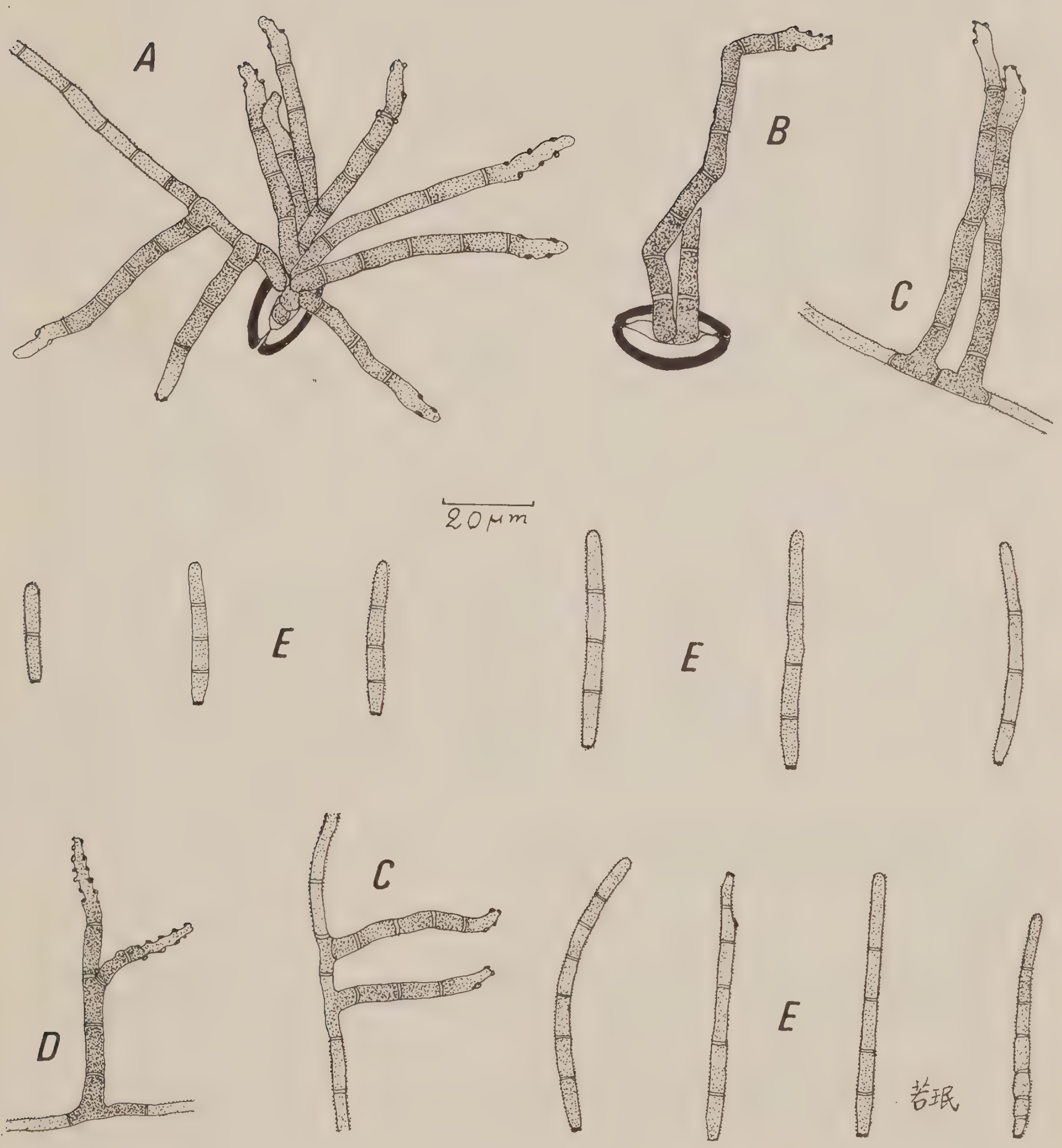

Fig. A-E, Stenella bougainvilleae Yen & Lim. A, Fascicle of conidiophores and formation of external hyphae; B, Geniculate conidiophore; C, External hyphae and formation of secondary conidiophores; D, Branched conidiophore; E, Conidia.

scattered, 1-7mm in diameter, often confluent on the terminal part of the leaf. Caespituli hypophyllous, invisible even under the hand lens. Primary mycelium internal: hyphae almost colorless, septate, branched, 1.5-2.5μm wide. Stomata not developed. Primary conidiophores hypophyllous, 2-8 in fascicles emerging through the stromata, simple or occasionally branched, erect below, attenuate and denticulate above, pale brown olivaceous and paler towards the tip, 3-8 septate, 0-3 geniculate, apex attenuate and decorate with small dark brown conidial cicatrices, 30-90 x 3-4μm. Secondary mycelium external: hyphae arising at the base of primary conidiophores and emerging through the stomata, pale olivaceous, repent, septate, branched, finely verruculose, 2-3μm wide, bearing laterally the secondary conidiophores, which are simimar in respect to the primary conidiophores. Conidia pale olivaceous, cylindric or subcylindric, finely verruculose, straight or slightly curved, generally 3-6 septate (rarely 1 or 2 septate), apex rounded, base attenuate-subtruncate and decorated with dark-brown conidial cicatrice generally not constrict, 20-65 x 2.5-4μm.

On *Bougainvillea spectabilis* Willd. (Nyctaginaceae), in Holland Road, Singapore, G. Lim, April 1980, No. SU 95 (Herb. LAM, Yen #10586).

Rao (1962) has described in India a *Cercospora bougainvilleae* P. N. Rao, parasiting also on *Bougainvillea spectabilis*; but it differs from ours by its hyaline conidia. On the other hand, Sobers and Seymour (1969) have described a *Cercosporidium bougainvilleae* (Munt.) Sob. & Seym. which differs from our fungus in having very dense fascicles and well developed stromata.

Cercoseptoria Cordiicola (Yen) Yen, comb. nov.
=*Pseudocercospora cordiicola* (Yen) Yen, Gard. Bull. Singapore 33:173, 1980.
=*Cercospora Cordiicola* (Yen) Yen, Rev. de Mycol. 32: 182, 1967.
=*Cercospora cordae* Yen, Rev de Mycol. 29: 216, 1964.
non *Cercospora cordae* Chupp, Mongr. Univ. P. R. Ser. B, 2: 245, 1934.

On *Cordia cylindristachya* (Boraginaceae), in Singapore.

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PHYTOPHTHORA OPERCULATA SP. NOV., A NEW MARINE FUNGUS

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In 1980 a species of *Phytophthora* resembling *P. vesicula* Anastasiou & Churchland was reported to be associated with trunk cankers and decayed absorbing rootlets of declining white mangrove trees (*Avicennia marina* (Forsk.) Vierh.) in the Gladstone area of central coastal Queensland (Pegg, Gillespie and Forsberg, 1980). During a study to determine the distribution of this fungus in Queensland mangrove communities, another *Phytophthora* with a unique method of zoospore release was recovered on several occasions from decayed white mangrove leaves submerged in sea water (Pegg and Forsberg, 1981). As this fungus has sporangial characters which differ from those of other *Phytophthora* species, it is described below as new.

Phytophthora operculata sp. nov. Figures 1-3

Hyphae hyalinae, ramosae, demum septatae, 8-10 µm diam. *Sporangiophora* non ramosa, sympodialia, torsiva, 6-7 µm diam. *Sporangia* subcylindrica vel anguste ellipsoidea, ad apicem late complanata, non caduca, 30-175 x 25-75 µm, obturamento septali in sporangium usque ad 13 µm protrudenti, ad apicem circumscissa. *Zoosporae* flagellis binis lateralibus, limoniformes vel fusiformes, globosae 10-12 µm diam. ubi incystatae. Reproductio sexualis ignota. Hab. in foliis putridis *Avicenniae marinae*, Moreton Bay, Queensland, 18.vi.1980, K.G. Pegg, BRIP 13362, holotypus; IMI 249911, isotypus.

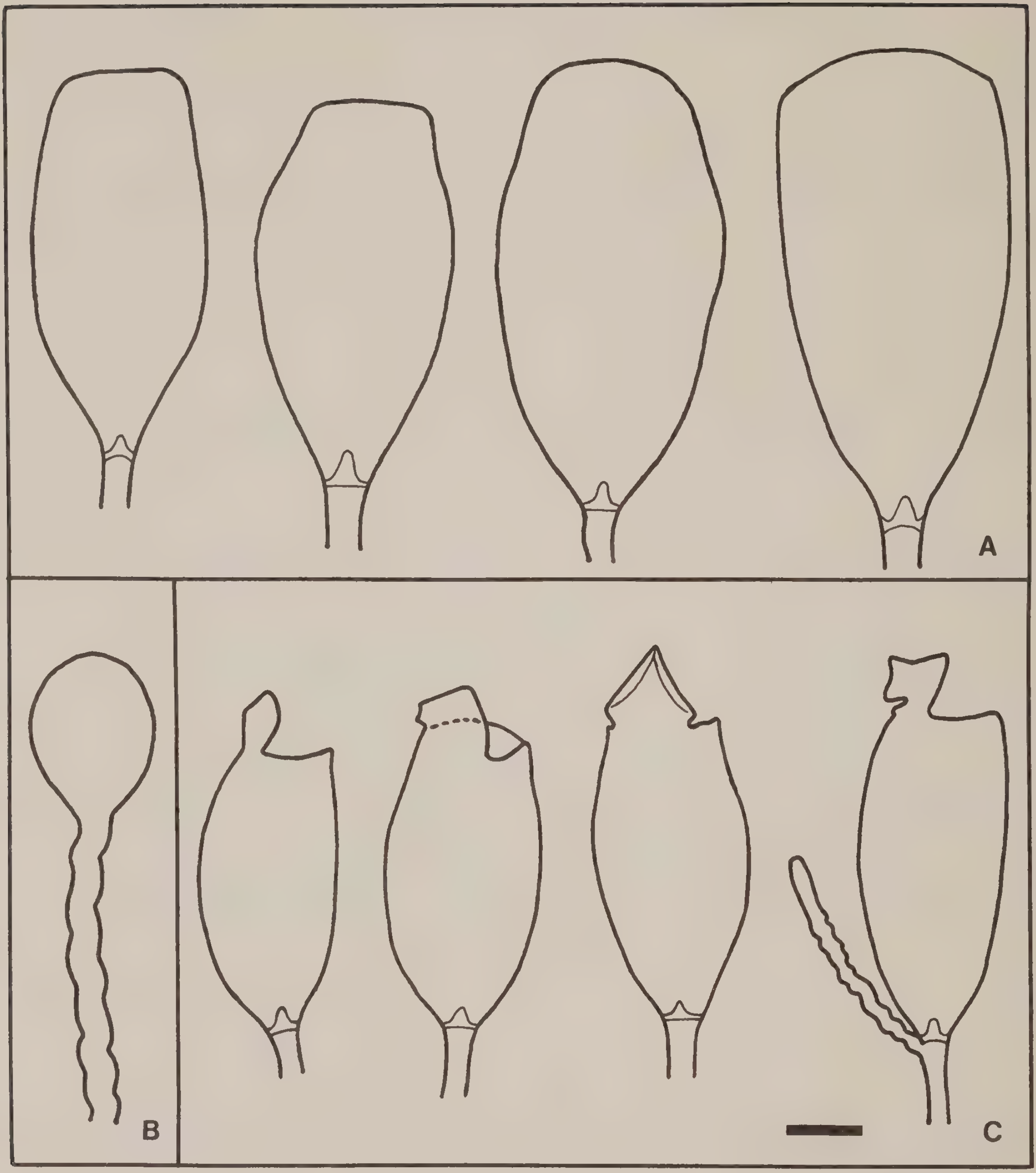

Fig. 1. Line drawings of *Phytophthora operculata* sporangia. A. Mature sporangia before zoospore release. B. Very young sporangium on spirally twisted sporangiophore. C. Sporangia after zoospore release (scale = 25 µm.

On solid media the mycelium is composed of freely branching hyphae 8-10 µm wide, non-septate when young but developing septa with age. Sporangia are produced sparingly on solid media in the absence of free water, and more abundantly when discs of V-8 juice agar or naturally-infected host tissue are immersed in autoclaved

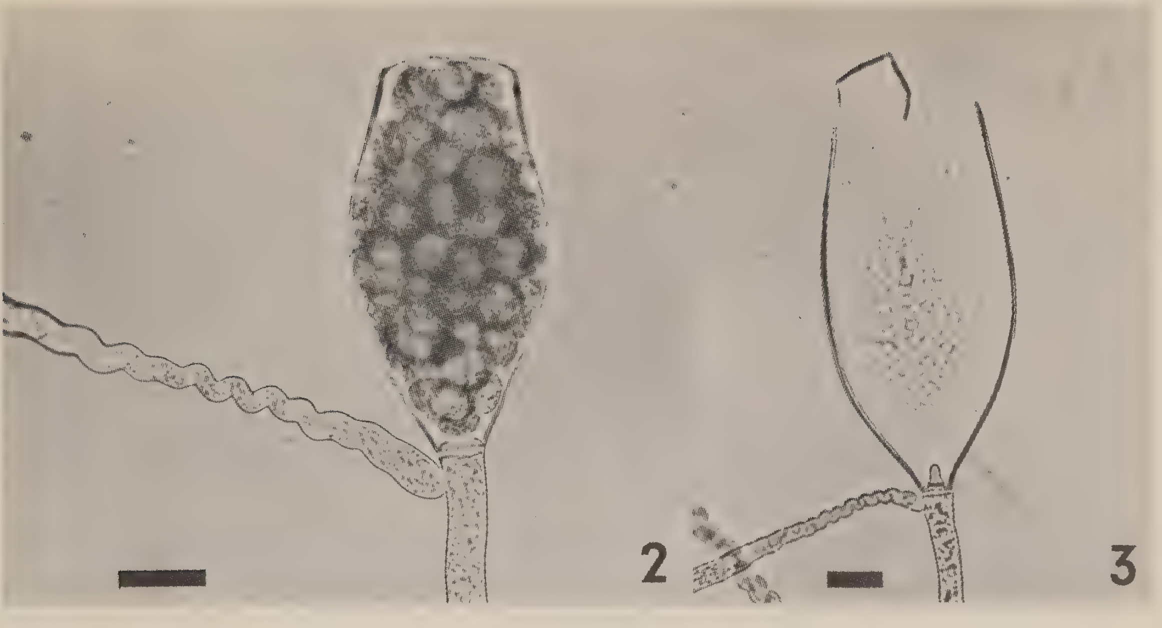

Fig. 2. Mature sporangium with differentiated zoospores, and sympodially elongating twisted sporangiophore (scale = 25 μm). Fig. 3. Sporangium after dehiscence, with prominent basal plug (scale = 25 μm).

sea water. They are borne in a lax monochasial sympodial arrangement on sporangiophores 6-7 μm diam., and which are in some parts twisted spirally (Fig. 2). Sporangia are non-deciduous, mostly narrowly ellipsoid, sometimes almost cylindrical, occasionally narrowed at the base, flat and broad at the apex, smooth-walled, 30-175 x 25-75 μm (Fig. 1). There is a conspicuous basal plug which protrudes 2.5-13 μm into the sporangium. Zoospores differentiate fully within the sporangium. A circumcissile split occurs near the sporangium apex, allowing an operculum to open and release the zoospores without formation of a vesicle. The edges of the operculum sometimes curl (Figs. 1, 3), but sporangia do not collapse after dehiscence. Radial growth on corn meal agar after 5 days at 35°C was 4-7.5 mm, with no growth at 38°C. The minimum temperature for growth was 18°C, and the optimum in the range 21-31°C.

Sexual reproduction has not been observed. Oogonia and antheridia were not produced when isolates were grown in single culture, or when six isolates of the species were paired in all combinations on 20% V-8 juice agar, carrot agar, media containing B-sitosterol (Ribeiro, 1978), or on detached white mangrove leaves incubated in autoclaved sea water.

Isolates of *Phytophthora operculata* have been obtained from decaying white mangrove leaves collected from several localities in or adjacent to Moreton Bay, south-eastern Queensland. It differs from all other species described in the genus (Ho, 1981) by the presence on the sporangium of an apical lid which opens prior to zoospore release. Other species such as *P. bahamensis* Fell & Master, *P. epistomium* Fell & Master, and *P. mycoparasitica* Fell & Master also have unique methods of zoospore release (Fell and Master, 1975). It seems that marine *Phytophthora* species are likely to produce sporangia with characteristics not seen in terrestrial members of the genus.

Cultures have been deposited as IMI 249911 and ATCC 44952.

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THECAPHORA ANDROSACINA AND ENTYLOMA GAILLARDIANUM, NEW SPECIES OF USTILAGINALES

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The types of *Thecaphora androsaces* (Karsten) Gutner and *Entyloma gaillardiae* (Speg.) Speg., proved not to be smut fungi. Consequently, it was necessary that the smuts inhabiting *Androsace* and *Gaillardia* be described as new.

THECAPHORA ANDROSACINA Vánky, sp. nov.

Typus: Androsace maxima L., Hungaria, Comit. Fejér, pr. pag. Érd, "Kutyavár", V.1874, leg. J. A. Tauscher (Herb. Ustilag. Vánky no. 10751 in UPS).

Sori multitudinem granulosam-pulveream sporarum conglobatarum formantes. Glomeruli sporarum globosi, ovoidei usque parum elongati vel forma irregulares, 16–35 x 20–45 (–52) µm e sporis 2–15(–25?) facile discedentibus compositi. Sporae rotundato-polygonales, irregulares, cuneiformes vel elongatae, 8–15 x 11–19 µm, flavidulo-hyalinae usque dilute flavidulo-brunneae, pariete 0.8–1 µm crasso, in superficie contactus levi, in parte extrorsa dense et irregulariter verrucoso.

Sori in the seeds forming pale brown, granular-powdery mass of spore balls. Spore balls (Fig. 1) globose, ovoid to slightly elongated or irregular, 16–35 x 20–45(–52) µm, composed of 2–15(–25?) easily separating spores. Spores (Fig. 1) polyangularly irregular with rounded edges, cuneiform or elongated, 8–15 x 11–19 µm in diameter, yellowish-hyaline to pale yellowish-brown, wall 0.8–1 µm thick, smooth on the contact surfaces, coarsely and irregularly verrucose on the free surface.

Type on *Androsace maxima* L., Hungary, Distr. Fejér, near the village Érd, "Kutyavár", V.1874, col. J. A. Tauscher (Herb. Ustilag. Vánky no. 10751, located in UPS).

Several smut names have been mentioned in the literature on *Androsace*, but they were either based on non fungal material or nomenclaturally incorrect. Thus, Karsten (1907: 4) described *Ustilago androsaces* in the ovaries of *Androsace ?filiformis* Retz. as "Sori fusci, pulverulenti. Sporae sphaeroideae, laeves, 35–50 µ diam.". Liro (1924: 343) examining the original specimen of Karsten found that it only contains young seeds which were mistaken by Karsten for smut spores. Lavrov (1936: 31) found a smut forming loose spore balls in the seeds of *Androsace maxima* L., considered it identical with *Ustilago androsaces* and made the combination *Sorosporium androsaces* (Karsten) Lavrov. Gutner (1941: 191) transferred this species to *Thecaphora* as *T. androsaces* (Karsten) Gutner. Săvulescu (1957: 869), though aware of Liro's finding, used the illegitimate name *Thecaphora androsaces* (Lavrov) Gutner. Another binomial for an *Androsace* smut is the herbarium name "*Thecaphora jubilei* Jacz. n. sp. ined in herb. VIZR", mentioned by Lavrov (1936: 31), which in his opinion is identical with *Sorosporium androsaces*.

ENTYLOMA GAILLARDIANUM Vánky, sp. nov.

Typus: Gaillardia aristata Pursh, (cult.) Romania, Transsylvania, Tîrgu-Mureș, alt. 325 m.s.m., 9.IX.1961, leg. K. Vánky. Holotypus: Herb. Ustilag. Vánky no. 743 in UPS; isotypi in Vánky, Ust. 44 et in Herb. myc. roman. 1725 (sub Entyloma compositarum).

Sori conspicui sicut maculae dispersae vel gregariae foliorum diametro 0.1–5 mm vel confluentes majores, initio dilute flavidulo-virides deinde brunnei, saepe cum margine tenui flavidulo. Sporae globosae usque forma irregulares, magnitudine variae, 9–15 µm in diam., subhyalinae usque flavae, pariete levi, saepe bistratoso, 1–2(–4) µm crasso.

Sori in the leaves as circular, scattered or gregarious spots of 0.1–5 mm in diameter, or more by confluence, at first pale yellowish-green, later brown, often with a thin yellowish margin. Spores (Fig. 2) globose to irregular, variable in size, 9–15 µm in diameter, subhyaline to yellow, with smooth, often two-layered, 1–2(–4) µm thick wall.

Spegazzini (1925: 148) described *Entyloma gaillardiae* (Speg.) Speg., based on *Protomyces? gaillardiae* Spegazzini (1909: 284) on *Gaillardia doniana*, and characterized by spores 30–35 µm in diameter. Spegazzini (1909: 284) himself

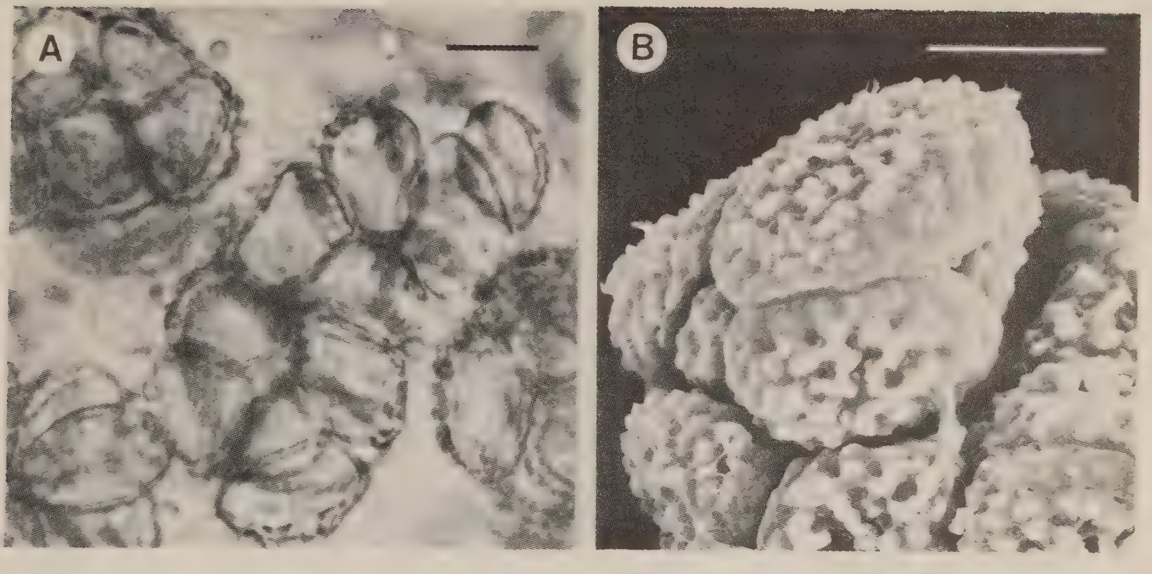

Fig. 1. Spore balls and spores of *Thecaphora androsacina* (type) seen in LM (A) and TEM (B). Bars = 10 µm.

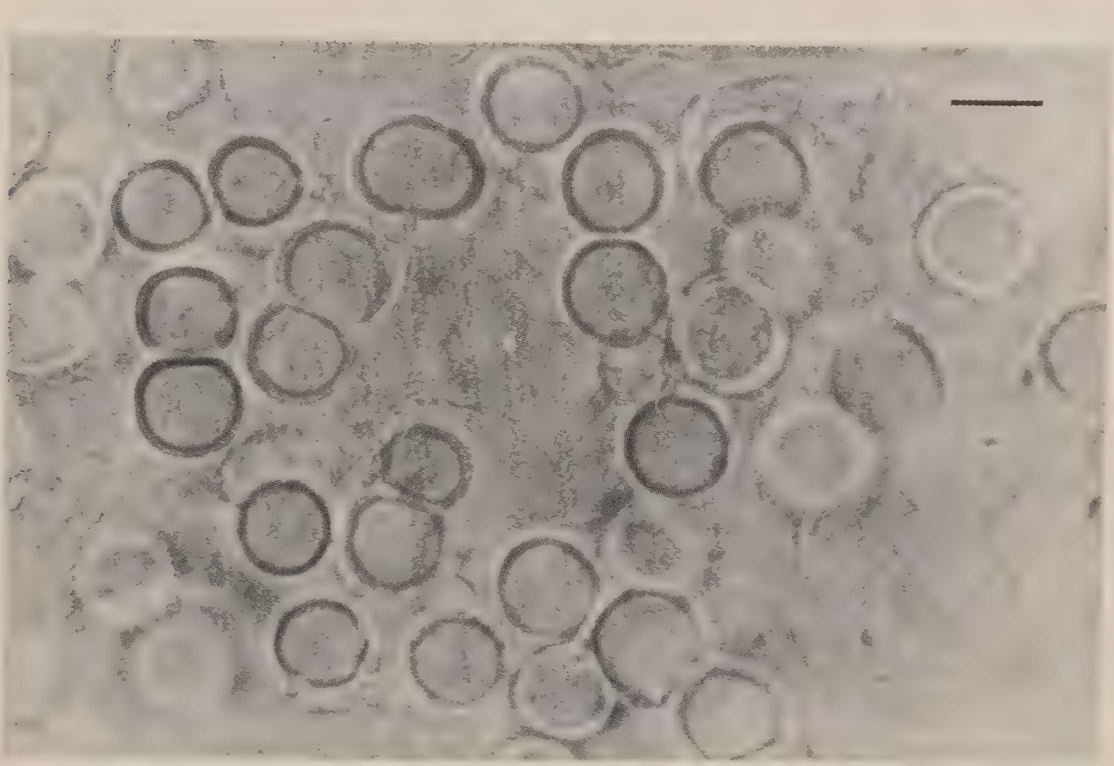

Fig. 2. Spores of *Entyloma gaillardianum* (type) in LM. Bar = 10 µm.

suspected that this fungus could represent oospores of Peronosporales. This opinion was also supported by Savile (1947: 117), Zundel (1953: 251) and Lindeberg (1959: 36). The true *Entyloma* smut on *Gaillardia* spp. was therefore referred by most of the authors to the collective species *E. compositarum* Farlow. However, by comparing *Entyloma* on *Gaillardia aristata* with *E. compositarum* (on *Aster puniceus* L., USA, Massachusetts, Wood's Holl, IX.1883, W. Trelease, in Ellis, N. Amer. fgi. 1492), I found that the first species has more irregular and somewhat larger spores, with thicker and often two-layered wall. In my opinion these are sufficiently distinct to consider the *Entyloma* on *Gaillardia* as a separate species.

ACKNOWLEDGEMENTS

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A NEW SPECIES OF ORBILIA FROM CANADA

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ABSTRACT

Orbilia piloboloides, a new species of Helotiales from the bark of *Ulmus americana*, is distinguished by its subapically swollen paraphyses which resemble the sporangiophores of *Pilobolus*. An anamorph with what appear to be sympodially produced blastoconidia is produced in culture.

Orbilia is one of the most easily recognized genera of Helotiales, yet relatively few treatments of the genus have been published (Dennis 1978, Svrček 1954, Seaver 1951) and many of its species are poorly known. Despite this, one taxon, represented by some recent Canadian collections is so markedly distinctive in having subapically swollen paraphyses and nearly fusoid spores that it is described here as a new species. All three collections are from relatively undecayed bark of *Ulmus americanus* L. and not on well-decayed, decorticated wood or herbaceous stems as is usual for *Orbilia*.

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The fungus was obtained in pure culture by placing a moistened apothecium on the lid of an inverted petri dish and allowing the ascospores to shoot upward onto the surface of 1.25% Malt agar. A characteristic anamorph was observed in culture.

ORBILIA PILOBOLOIDES Haines and Egger, *spec. nov.*

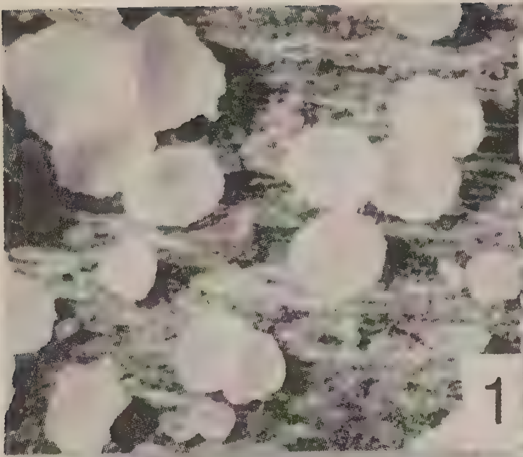
Apotheciis sessilibus ad brevi-stipitatis, aurantiluteis. Ascis (35-) 40-52 (-55) x 3-4 µm. Ascosporis 8-10 x 2.0-2.6 µm., fusiformibus ad naviculiformibus. Paraphysibus filiformibus cum bulbo apicali crassitunicato et cum gibba subapicali pyriformi tenuitunicato, 2.0-3.3 µm. diam.

Coloniis lentis crescentibus, hyalinis ad aurantis, rugulosis, semimucosis. Myceliis hyphoideis vel moniliformibus, ramosis, laevibus, hyalinis. Conidiophoris sympodialibus, 5-12 (-20) x 1.5-3 µm. Sympoduloconidiis laevibus, hyalinis, curvis, 1-septatis, 9-12 x 2-3 µm.

Holotype: DAOM 176753. Ginns' Farm, St. Elizabeth Road, Cantley, Gatineau Co., Quebec, Canada, April 22, 1980, J. H. Ginns. (100+ apothecia on 1 piece of substrate, 1 dried culture of anamorph, living culture in DAOM culture collection).

TELEOMORPH: Apothecia (Fig. 1) scattered to gregarious on relatively undecayed bark, luteus when hydrated, darkening to orange-luteus on drying, waxey-appearing, often with a glaucus coating most noticeable as a white fringe at the margin, cupulate at first, becoming planate at maturity, up to 1.5 mm diam., folding or curling inwards at the margin on drying, sessile to short-stipitate. Stipe, when present, 0.2-0.3 mm diam. by up to 0.3 mm high, lighter-colored than cup, sometimes with a restricted web of hyphae at the base. Exciple (Figs. 6 and 8) composed of thin-walled, hyaline cells 5-15 µm across forming textura angularis. Asci (Fig. 3) (33-) 40-52 (-56) x 3-4 µm, 8-spored, cylindrical in upper two thirds, tapered in lower third to a contorted base 1-2 µm across, apparently not subtended by croziers, distinctly truncated and sometimes slightly enlarged at the apex, without visible pore or amyloid reaction, thin-walled throughout. Spores (Fig. 4) 8-10 x 2.0-2.5 µm, short-naviculate to fusoid, bilaterally symmetrical, slightly more acute at the apex than base, nonseptate, smooth, thin-walled, without conspicuous internal

Figs. 1-8 *Orbilia piloboloides*. 1. Apothecia on natural substrate, approx. 12X. 2. Hymenium 500X. 3. Asci 1,000X. 4. Ascospores 1,000X. 5. Paraphyses 1,000X. 6. Section of apothecium 400X. 7. Asci and paraphyses 1,000X. 8. Detail of ectal exciple 1,000X. (All from the holotype).



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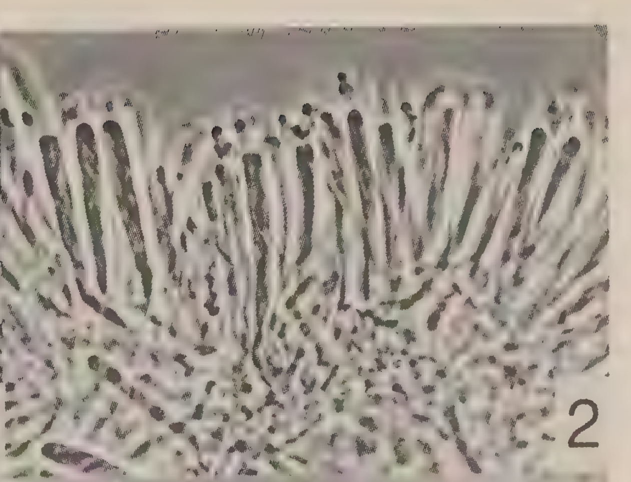

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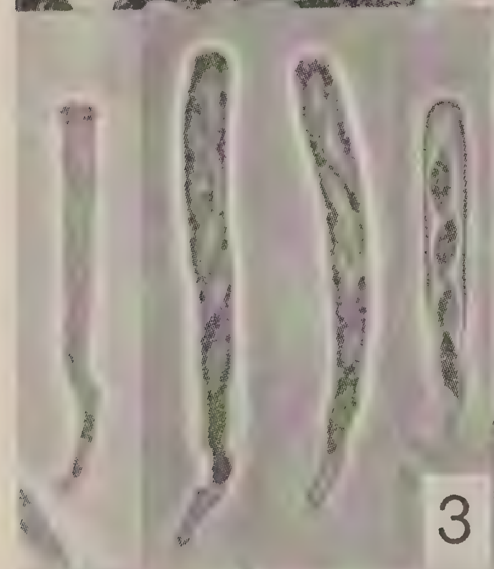

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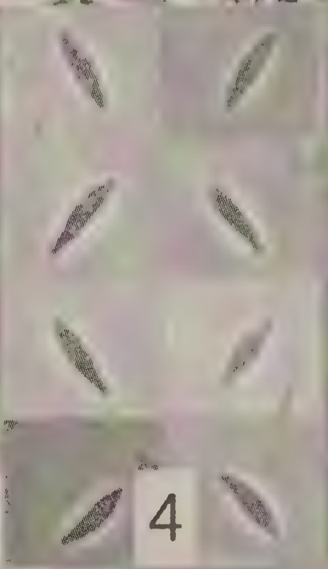

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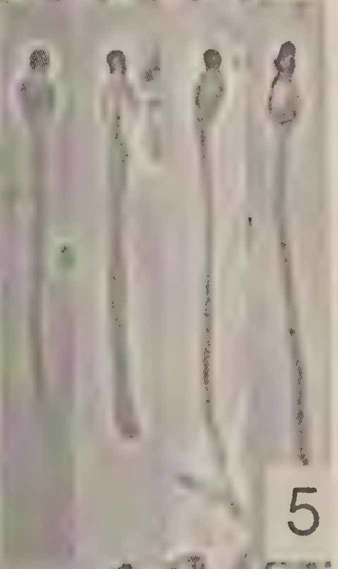

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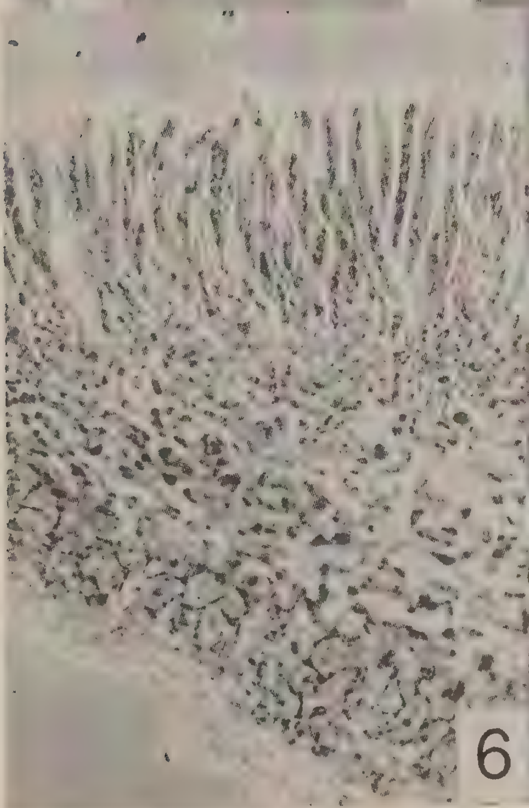

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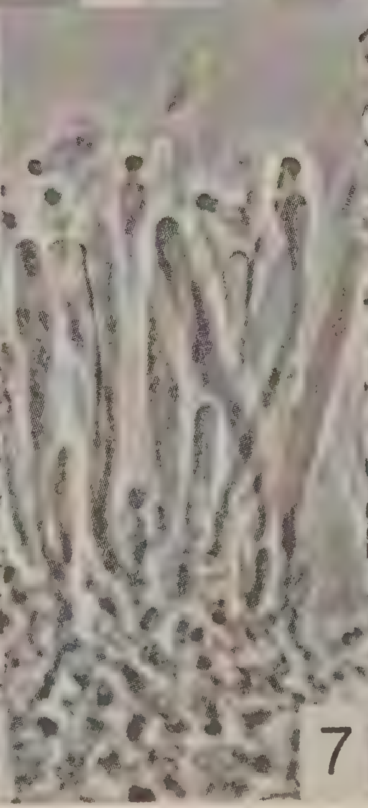

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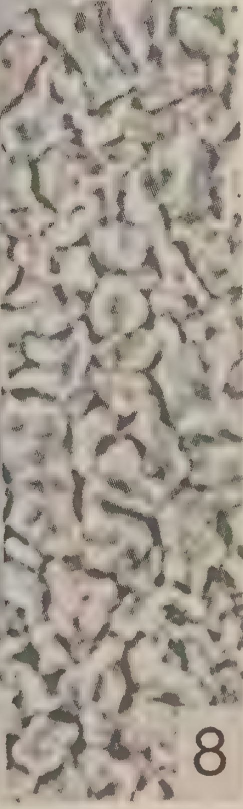

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features. Paraphyses (Fig. 5) filiform, 0.9-1.2 µm diam. in the lower portion, swollen at the apex to a distinct spherical, thick-walled knob 1.1-1.8 µm diam. subtended by a thin-walled, pyriform swelling 2.0-3.3 µm diam., often with a few amorphous particles adhering to the surface, extending beyond the asci by a few microns in the hymenium. Hymenial components not adhering, easily separated by pressure on squash mounts (Fig. 2, 7).

ANAMORPH: Colonies submerged or appressed to the surface of agar, rugulose, dense, surface somewhat slimy, hyaline on 1.25% malt agar and potato carrot agar to white on potato dextrose agar, developing a light orange pigment when exposed to ultraviolet; slow-growing (6-10 mm in 10 days at room temperature). Hyphae (Fig. 9) hyaline, smooth, sparingly septate, branched, 1.2-2.5 µm wide, occasionally interspersed with moniliform mycelium with elliptical swellings up to 4 µm wide, septate at 4-8 µm intervals and constricted at the septa. Conidiophores (Figs. 10, 11, 12) sympodial, hyaline, lageniform to cylindrical, 5-12 (-20) x 1.5-3 µm, arising from undifferentiated mycelium, usually with one to three denticles at the apex or occasionally with an elongated rachiform apex. Sympoduloconidia (Fig. 13) apparently blastic, smooth, hyaline, strongly curved with an obtusely rounded apex and a narrowly truncate base, 9-12 x 2-3 µm, with a single median septum, not constricted.

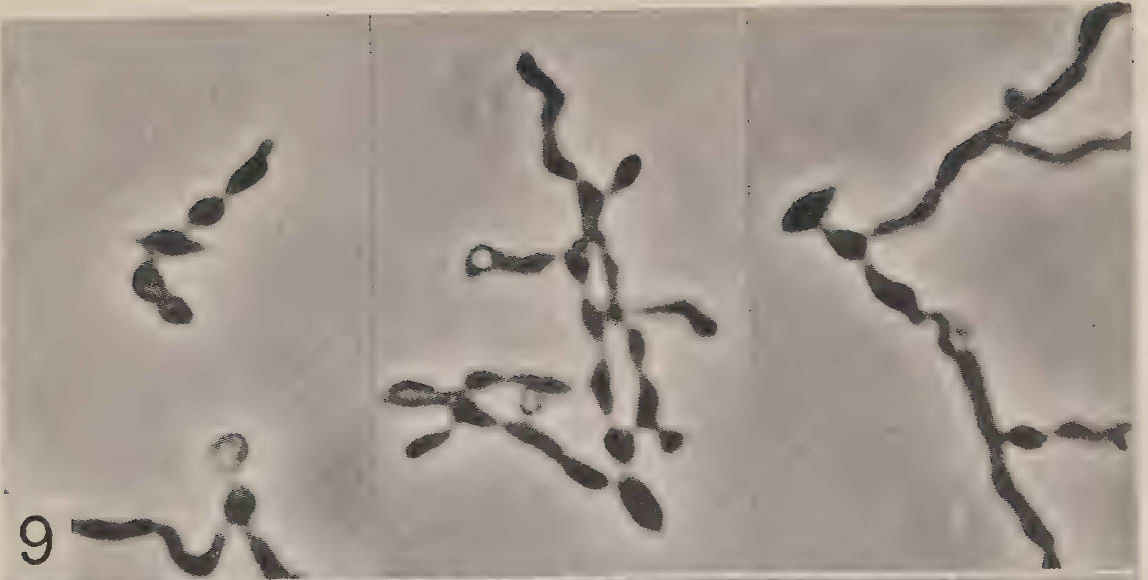
SUBSTRATE AND HABITAT: Bark of mature, standing or disintegrating *Ulmus americana* killed by dutch elm disease. Often, if not always, originating from the upper parts of the trees (J. Ginns, personal communication).

ETYMOLOGY: piloboloides = *Pilobolus* -like. Refers to the paraphyses which resemble the sporangiophores of the zygomycete *Pilobolus* Tode.

COLLECTIONS EXAMINED: CANADA: Quebec: Ginns' Farm, 45° 34'N, 75°47'W, St. Elizabeth Road, Cantley, Gatineau Co., on bark of log of *Ulmus americana* 22 April 1980, J. H. Ginns, DAOM #176753 (Type) DAOM, (Isotype) NYS 26 October 1980, J. H. Ginns DAOM #177611, (DAOM, NYS). Ontario: North Gower, on inner bark of log of *Ulmus americana*, 16 July 1979, G. P. White #169, DAOM #176754 (DAOM).

DISCUSSION: This species is immediately recognizable as a member of the Orbiliaceae by its waxey, orange apothecia, its small flat-topped asci without apparent pores, knob-tipped paraphyses and globose or angular-celled excipulum.

Figs. 9-13 *Orbilia piloboloides*. 9. Germinating ascospores. 10, 12. Sympoduloconidia and conidiophores of anamorph. 11. Conidiophore apices showing rachiform development. 13. Mature conidia. All at 1,000X. 9. from DAOM 17764. 10-13. from culture of holotype.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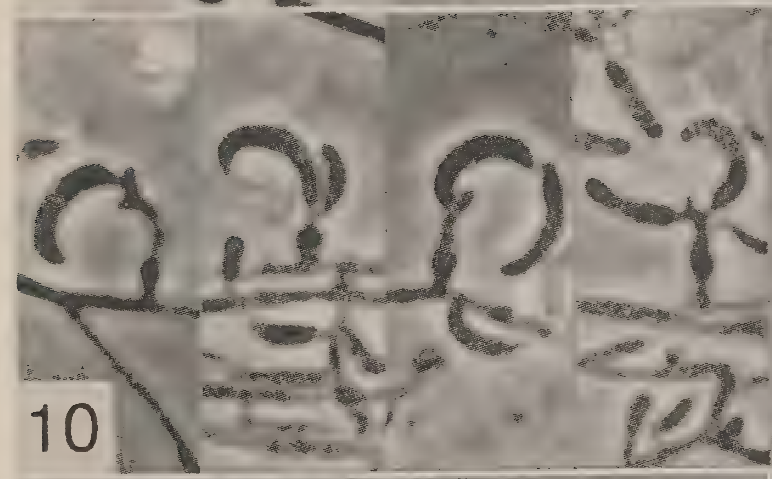
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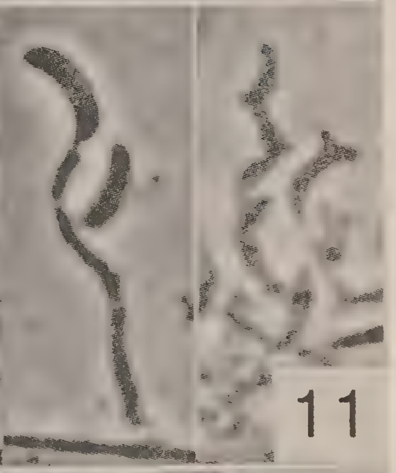
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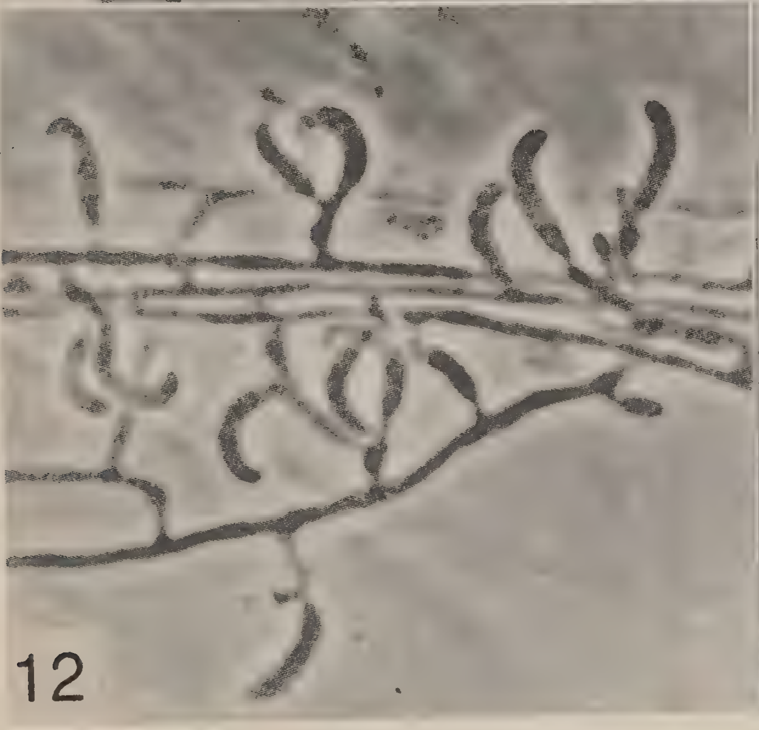
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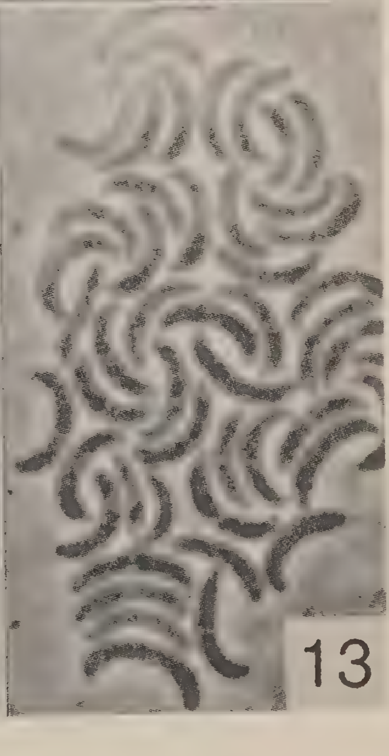
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It is distinguished from all other species by its unusual paraphyses which resemble sporangiophores of the zygomycete *Pilobolus*. The similarity is entirely superficial, however, and there is no evidence that the paraphyses are directly involved in dispersal. The ascospores are small and non-septate as in other orbilias but they have a shape not previously described for any other member of the genus.

Recent studies (Benny, Samuelson and Kimbrough 1978) have demonstrated the presence of a blue-green algal (Cyanobacterial) associate in the excipular tissue of *Orbilia luteorubella* (Nyl.) Karst. Although one of us (JH) has confirmed these findings and has observed algal cells in several other species of *Orbilia*, none were found in *O. piloboloides*. The presence of algal cells in the lower apothecial tissues of orbilias appears to be correlated with conditions suitable for an abundance of photosynthetic organisms on the substrate surface. *Orbilia piloboloides* occurs on substrate relatively poor in these organisms.

Hymenial components which are firmly held together in a glutinous matrix are common for some species of *Orbilia* but those of *O. piloboloides* do not appear to be embedded and are easily separated by applying pressure on squash mounts. Stipitate species are rare in the genus. *Orbilia piloboloides* often has a short stipe, but it is a variable character which may be influenced by the environment near the substrate.

We do not feel that the anamorph of *O. piloboloides* can be accommodated in any known genus. However, there does not seem to be a case at this time for erecting a new genus.

Berthet (1964) described an anamorph of *Orbilia xanthostigma* (Fr.) Fr. with conidia of two types: fusoid didymoconidia and "horseshoe-shaped" bilobed conidia. This anamorph has been referred to *Dicranidion* Harkn. (fide Hennebert and Bellemere, 1979). Butterfield (1973) also noted the presence of lobed conidia and phragmoconidia in *D. fragile* Harkn. The anamorph of *O. piloboloides* does not have bilobed conidia and the conidia are curved rather than fusoid, although the method of conidium production is similar to *Dicranidion*. *Diplorhinotrichum* Höhnel (= *Dactylaria* Sacc., fide Bhatt and Kendrick, 1968) has been used for a group of fungi with hyaline didymoconidia on sympodial conidiophores, but the conidia are not curved. *Idriella* Nelson and Wilhelm, which has a *Hymenoscyphus* teleomorph (Kimbrough and Atkinson, 1972), and *Microdochium* Syd. (Sutton, Pirozynski and Deighton, 1973) are similar fungi. *Idriella spp.* produce dark chlamydospores in culture and has a faster growth rate than our species. *Orbilia piloboloides* produces moniliform hyphae in culture but these do not become pigmented. *Microdochium* is known primarily from the natural substrate. At least one species, *Microdochium phyllanthi* Sutton, Pirozynski and Deighton, does not produce chlamydospores in culture but does produce a dark brown pseudoparenchymatous stroma. *Orbilia piloboloides* produced no stromata in culture.

ACKNOWLEDGEMENTS: The authors wish to thank Dr. J. D. Bissett for his advice and discussions during the development of this paper and Dr. J. Ginns for kindly offering fresh collections for culturing. Thanks also to Drs. Scott Redhead and James Kimbrough for their helpful comments.

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PHELLINUS ANDINA PLANK & RYV. NOVA SP.

by

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Abstract

Phellinus andina is described from Argentina. It is characterized by a resupinate fruitbody, short tramal setae in the dissepiments and large, subglobose, golden brown spores.

Under an expedition to Argentina, one of us (S. Plank) collected a Phellinus species with a unique combination of characters and for which we could not find a name.

Phellinus andina Plank & Ryv. nova sp.

Fructificatio resupinata, effusa, adnata marginibus subtiliter floccosis, 1-3 mm latis, pallide tabacinis. Facies pororum umbrina poris rotundis, 6-7 per mm, tubis concoloribus, ad 500 um altis. Subiculum cinnabarinum ad tabacinum. - Systema hypharum dimiticum: hyphae sceletales crasse tunicatae, aureae, alterae in trama, alterae in tubarum dissepimentis sitae, 2-3.5 um latae, hyphae in subiculo et in margine sitae ad 5 um latae luminibus latioribus. Hyphae generatoriae hyalinae, septis simpliciter septatae, 2-3 um latae. Setae vel hyphae setoideae in dissepimentis adsunt, breviter emergentes, pullae, crasse tunicatae, rectae vel leviter curvulae, 4-7 um latae, 35-60 um longae. Setae hymeniales desunt. Basidiae claviformes, 10-20 um longae, 4-6 um latae, sterigmatibus 4. Basidiola evoluta hyalina,

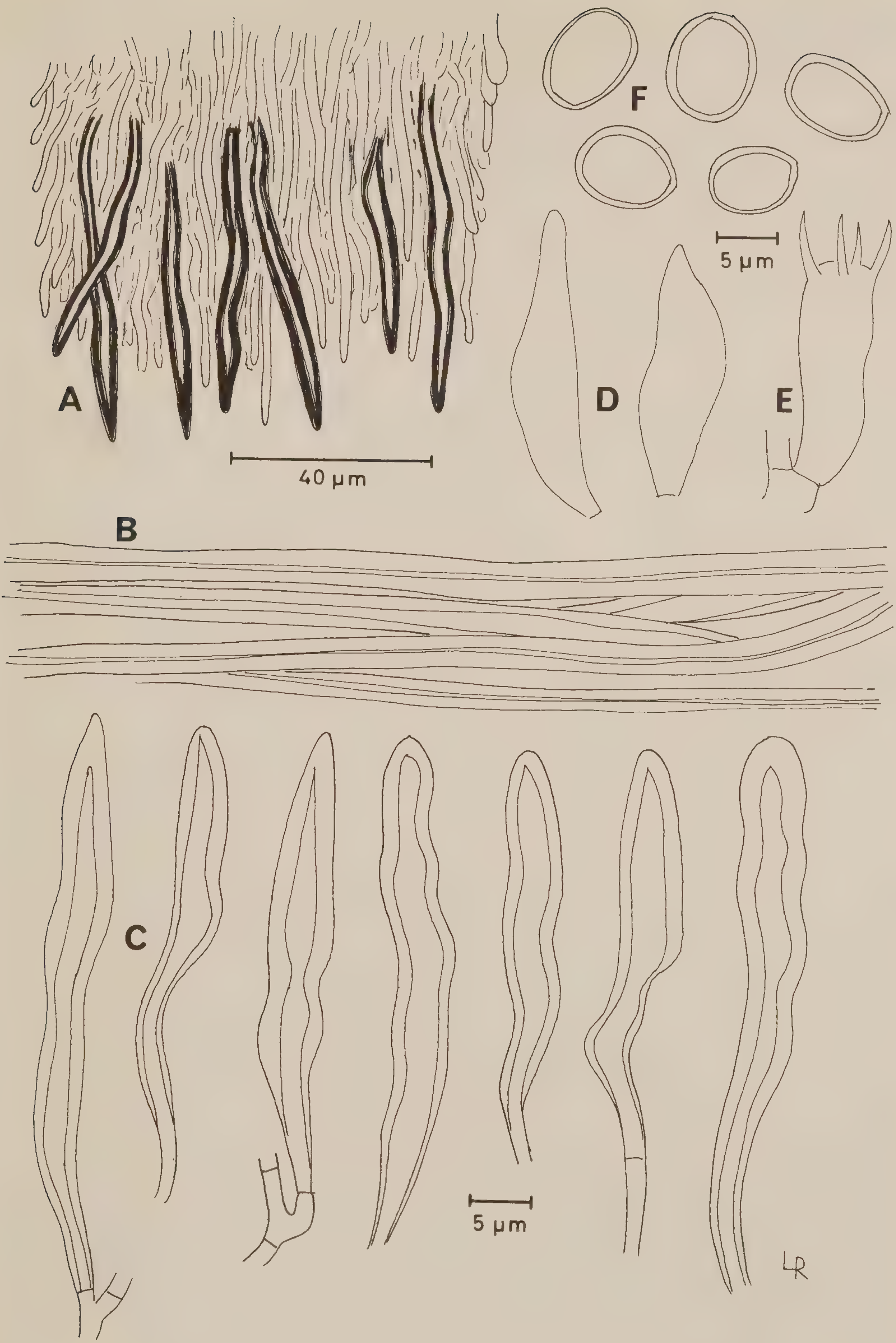

Fig. 1. Phellinus andina. A) Section through the dissepiments, B) skeletal hyphae from the trama, C) setae from the dissepiments, D) basidiols, E) basidium, F) spores. From the type.

10-20 um longa, ventricosa. Sporae subglobosae, ad late ellipsoideae, crasse tunicatae, aurei-umbrinae, 7-9/5.5-7 um.

Typus: Ad truncum mortianum Myrceugenellae apiculatae (Myrtaceae). In Argentina, regio Rio Negro (Andes), "Bosque de Arrayanes" apud lacum "Nahuel Huapi", ca. 800 m. Leg. S. PLANK & M. F. BROGGI, 26.01.1981

Holotypus: GZU.

Isotypi: Oslo, K, BPI, Coll. auct. Graz (S-AM/ARG 9).

Fruitbody resupinate, effused and adnate. Margin finely floccose, 1-3 mm wide, pale snuff brown, pore surface umber brown, pores round, 6-7 per mm, tubes concolorous, up to 500 um deep, context deep cinnamon to snuff brown, dense and up to 1 mm thick. Hyphal system dimitic, skeletal hyphae thick-walled and golden brown, in the trama 2-3.5 um wide, in the context and margin up to 5 um wide and with a wider lumen. Generative hyphae hyaline, simple septate and 2-3 um wide. Tramal setae or short setal hyphae present in the dissepiments, slightly projecting, dark brown, thick--walled, straight to somewhat sinuous 4-7 um wide, 35-60 um long. Hymenial setae absent, Basidia clavate 15-20 x 4-6 um with 4 sterigmata, basidiols present, ventricose, hyaline 10-20 um long, spores subglobose to broadly ellipsoid, thick-walled and golden brown by maturity, 7-9 x 5.5-7 um. Only known from a died stem of Myrceugenella apiculata (Myrtaceae).

The short tramal setae restricted to the dissepiments make this species unique in Phellinus. Such setae are known in Inonotus, such as in I. hastifer Pouz., but have hitherto been unknown in Phellinus. Furthermore, the large spores are also unusual in the genus where most species have spores shorter than 7 um. The new species reminds in several respects about an Inonotus species, but the distinct dimitic hyphal system with thick-walled, narrow skeletal hyphae rules out a place in the genus.

Acknowledgements.

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A REINVESTIGATION OF THE NORTH-WEST HIMALAYAN PULVINULAS

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SUMMARY

On a reinvestigation, it has been found that the N.W. Himalayan specimens of *Pulvinula* Boud. belong to *P. mussooriensis* (Thind, Cash & Singh) Batra, *P. globifera* (Berk. & Curt.) Le Gal, *P. orichalcea* (Cke.) Rifai, *P. convexella* (Karst.) Pfister, *P. laeterubra* (Rehm) Pfister, *P. nepalensis* R. Kaushal sp. nov., *Pulvinula* taxonomic sp. I and *Pulvinula* taxonomic sp. II. A key to all these species is given.

Species of *Pulvinula* Boud. from N.W. Himalayas have been poorly understood. For example, Thind & Batra (1957), Thind & Singh (1959) and Thind et al. (1959) probably were not clear about its generic concept when they treated species of *Pulvinula* under *Lamprospora* de Not. Later, Batra & Batra (1963) evidently were confused over these two genera. They listed some species under *Pulvinula* but at the same time described at least one of its species under *Lamprospora*. Subsequently, more *Pulvinula* species were described from the N.W. Himalayas by Thind & Waraitch (1970) and Waraitch & Thind (1977). The recent delimitation of species of this genus by Rifai (1968), Moravec (1969) and Pfister (1972, 1976), and the importance of critical microscopic observations for proper identification led the author to re-examine collections from the N.W. Himalayan ranges of India and Nepal where the earlier Indian researchers made their collections. An attempt has been made here to place the collections (both published and unpublished) in the species as understood now.

As a result of these investigations, it has been found that from among the earlier reports of the *Pulvinula* species from N.W. Himalayas, only *P. mussooriensis* (Thind, Cash & Singh) Batra was valid. Besides *P. mussooriensis*, N.W. Himalayan specimens have been found to represent seven more species viz., *P. globifera* (Berk. & Curt.) Le Gal, *P. orichalcea* (Cke.) Rifai, *P. convexella* (Karst.) Pfister, *P. laeterubra* (Rehm) Pfister, *P. nepalensis* R. Kaushal, sp. nov., *Pulvinula* taxonomic sp. I and *Pulvinula* taxonomic sp. II.

A key to all the N.W. Himalayan species of *Pulvinula* has been provided in this work. Comments have been included for the collections which are at minor variance with the described species. Collections have been commented under the species to which they were assigned by the earlier workers.

Pulvinula carbonaria (Fuck.) Boud. var. *brevispora* Batra

Thind & Batra (1957) first described this fungus (No. 154) as *Lamprospora carbonaria*, but later Batra in Batra & Batra (1963) shifted it to *Pulvinula* and raised a new variety *brevispora*. The collection is in decayed condition in preservative and, except for the size of ascospores (up to 14 µm across) and filiform, curved paraphyses which are not enlarged apically, nothing more could be made out of it. Going by Thind & Batra's description, except for the pyrophilous habitat it does not seem to be different from *P. orichalcea* (Cke.) Rifai. Specimen examined: India: Batra 154 (PAN), on charcoal beds which were overgrown by mosses, Jabber Khet, Mussoorie, August 20, 1952.

Pulvinula constellatio Boud.

This species has been tentatively regarded as a synonym of *P. convexella* (Karst.) Pfister by Pfister (1976). CUP-In 27 referred to *P. constellatio* by Batra & Batra (1963) has ascospores 15.8-18 µm across, asci 194-248 µm long, with regular croziers and filiform, curved and branched paraphyses. In my opinion it represents *P. convexella*. Specimen examined: India: Batra 27 (CUP-In), on soil, Dhobi Ghat, Mussoorie, U.P., September 1952.

Pulvinula discoidea (P. Henn. & Nym.) Batra

I follow Pfister (1976) who does not recognize this species in the absence of its type material. CUP-In 19 described by Batra & Batra (1963) as *P. discoidea* has few, small (about 1.5 mm in diam.) whitish apothecia, which are not well preserved. The asci are 215-252 x 18-21 µm, 8-spored, tapering below, with regular croziers. The ascospores are 16-18 µm across and have many small oil droplets. The paraphyses are unbranched, up to 1.8 µm wide at the base and are up to 4 (-5) µm wide above at their bent apices. In ascospore size it is unlike any of the other white species of this genus and it seems to be a new species (*Pulvinula* taxonomic sp. I). Owing to Batra's insufficient and poorly preserved material, I am not naming this species. I have some good material of this fungus from the Eastern Himalayas which would be published shortly. Specimen examined: India: Batra 19 (CUP-In), on soil, mossy falls, Mussoorie, U.P.

Pulvinula etiolata (Cke.) Le Gal

The specimen used by Le Gal (1953) to describe *P. etiolata* has been referred to *P. tetraspora* (Hansf.) Rifai by Rifai (1968) who has described its position in detail. No. 2039 assigned to *P. etiolata* by Thind & Waraitch (1970) has small (up to 2.5 mm in diameter) whitish apothecia. These bear 8-spored asci up to 235 µm long, tapering at the base and arising from regularly two-pronged croziers, ascospores up to 12.8 (-13) µm in diameter, paraphyses filiform with curved apices up to 1.6 µm wide throughout their length.

This Himalayan collection seems not to be different from

P. globifera (Berk. & Curt.) Le Gal sensu Rifai. Though its relatively smaller apothecia and ascospores, and the form of the paraphyses bring it nearer to *P. lacteoalba* J. Moravec, this species except for its 4-spored asci, may not be different from *P. globifera* as noted by Pfister (1976). Specimen examined: India: Waraitch 2039 (PAN), on humicolous soil amongst needles of some conifers under coniferous forest, Baghi, Simla, H.P., August 19, 1966.

Pulvinula globifera (Berk. & Curt.) Le Gal sensu Rifai

PAN 2322 referred to this species by Waraitch & Thind (1977) has yellow apothecia up to 3 mm in diameter and pyrophilous habitat. The asci are 180-218 x 14-18 µm, 8-spored, instead of tapering below become slightly narrower, then abruptly contracted into a short cylindrical stalk-like base and lack regular croziers. The ascospores are 12.8-15.5 µm across and the paraphyses are up to 1.6 µm wide below, expanding up to 3 µm at their bent to curved apices.

Its substrate, the type of ascal bases and size of ascospores are unlike *P. globifera*. *Pulvinula neotropica* Pfister, a pyrophilous species, is close to it but has pale yellowish-greenish apothecia and smaller asci arising from prominent croziers. The similar ascal bases, somewhat similar ascospore size and apically inflated paraphyses alienate this Nepalese collection to some extent with *P. miltina* (Berk.) Rifai, but the latter is distinct in its crimson apothecia, terricolous habitat and longer asci (up to 265 µm, fide Rifai, 1968). Waraitch's collection seems to represent a new species for which I propose Pulvinula nepalensis R. Kaushal sp. nov.* Specimen examined: Nepal: Holotype: Waraitch 2322 (PAN), on charcoal and burnt soil around a fire place in Bamboo grove, Sundarijal, Kathmandu, August 15, 1969.

Pulvinula haemastigma (Hedw. ex Fr.) Boud.

I follow Pfister (1976) and consider *P. haemastigma* a 'nomen confusum.' Batra & Batra recorded this fungus in their check-list of "Indian Discomycetes" as *P. haematostigma* [sic]. Under this species they have not cited the number of their collection deposited at PAN and it could not be located there.

There are four unpublished collections at PAN, labelled as *P. haemastigma*. No. 2251 and 2264 except for their smaller apothecia (up to 2 mm in diameter) and somewhat smaller asci (204-240 x 17-19 µm) are typical of *P. convexella* (Karst.) Pfister in their basally distinctly forked asci with regular croziers, size of ascospores (16.4-18.8 µm across) and apically regularly branched filiform paraphyses.

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*Apothecia ad 3 mm diam., disciformia, flavida. Asci 180-218 x 14-18 µm, octospori. Ascospori 12.8-15.5 µm diam., globosi, laevigati. Paraphyses filiformae, ad 3 µm ad apices. Holotypus: Waraitch 2322 (PAN).

In No. 2470 and 2562 ascospores are 14-18.6 µm across and asci 224.5-250 x 14.5-19 µm which also fall in the range of *P. convexella*, but their ascal bases instead of arising from two-pronged regular croziers are simple, tapering and lacking regular croziers and also the regular branching of the paraphyses is lacking in them. These could not be assigned to *P. miltina* because of the latter's abrupt type of ascal base and different color. *P. orichalcea* seems to be the closest but has smaller ascospores. Probably these two collections represent a new species (*Pulvinula* taxonomic sp. II). Specimens examined: India: Waraitch 2251 (PAN), on much wet soil, Harwan, Srinagar, J & K, August 27, 1967; Waraitch 2264 (PAN), on much wet soil amid mosses along a streamlet, Joru Pur, Bijbihara-Pahalgam Road, J & K, September 24, 1967; S. Chander 2470 (PAN), on wet soil, Banikhet, Dalhousie, H.P., August 11, 1972; S. Chander 2562 (PAN), on wet soil, Kilbury, Nainital, U.P., August 22, 1973.

Pulvinula haemastigma (Hedw. ex Fr.) Boud. var. *gigantea* (Thind & Singh) Waraitch & Thind

This variety, earlier published as *Lamprospora haematostigma* var. *gigantea* by Thind & Singh (1959) to accommodate No. 296, was later transferred to *Pulvinula* and validated by Waraitch & Thind (1977) who also added two more collections, No. 2338 and No. 2339 to it.

In No. 296 the type of asci and paraphyses and the size of ascospores are similar to those in *P. orichalcea* and should be taken as a representative of this species. No. 2338, 2339 along with Nos. 2131 and 2342 (unpublished and deposited at PAN as *P. haemastigma* var. *gigantea*) in my opinion also belong to *P. orichalcea*. Specimens examined: India: Singh 296 (PAN), on humus amid mosses in oak forest, Brewery Road, Mussoorie, U.P., August 10, 1956; Waraitch 2131 (PAN), on moist and sandy soil in mixed forest, Panj Pulla, Dalhousie, H.P., August 17, 1966. Nepal: Waraitch 2338 (PAN), on wet clayey soil in angiospermous forest, Godaveri, Kathmandu, September 7, 1969; Waraitch 2339 (PAN), on wet sandy soil amid mosses in oak forest, Daman, September 12, 1969; Waraitch 2342 (PAN), on wet sandy soil in Oak forest, Daman, September 12, 1969.

Pulvinula mussooriensis (Thind et al.) Batra

This species, proposed by Thind et al. (1969), has been commented upon by Pfister (1976) who considered it to be very near *P. niveoalba* J. Moravec, and I also concur with him. Specimen examined: India: Type: Singh 306 (PAN), on soil amid mosses, Brewery Road, Mussoorie, U.P., August 12, 1956.

Pulvinula taxonomic sp.

Waraitch & Thind (1977) published this fungus to accommodate Nos. 2327 and 2349. These have yellowish apothecia, 11.2-14 µm across ascospores and up to 250 µm long asci with tapering base arising from distinct crozier. These appear to represent the yellow form of *P. laeterubra*. Specimens examined: Nepal: Waraitch 2327 (PAN), on wet clayey soil in angiospermous forest, Balaju, Kathmandu, August 22, 1969; Waraitch 2349 (PAN), on wet clayey soil in angiospermous forest, Balaju, Kathmandu, September 25, 1969.

Lamprospora multiguttulata Batra
CUP-In 104, the holotype of *L. multiguttulata*, which I received through the kindness of Prof. Richard P. Korf consists of only a slide of a vertical section of an apothecium. However, the sections are poor, and the ectal excipulum described as being compact textura intricata by Batra (1960) could not be confirmed. The ascospores are smooth, multiguttulate and the paraphyses are slightly bent. I fully agree with Rifai's annotation slip in the herbarium packet that CUP-In 104 is in no way related to *Lamprospora* and instead represents some species of *Pulvinula*. Since its microscopic features could not be fully reinvestigated, no attempt is made to place it. Specimen examined: India: Type: Batra 104 (CUP-In), on soil, Mussoorie, U.P.

KEY TO THE N.W. HIMALAYAN SPECIES

1. Apothecia white 2
1. Apothecia yellow, orange or reddish 3

2. Ascospores up to 12.8 (-13) μm in diameter; paraphyses up to 1.6 μm wide throughout their length . . . . *P. globifera*
2. Ascospores 16-18 μm in diameter; paraphyses up to 1.8 μm wide at the base and up to 4 (-5) μm wide at the apex . . *Pulvinula* taxonomic sp. I

3. Asci without prominent, two-pronged croziers 4
3. Asci with prominent, two-pronged croziers 6

4. Apothecia yellow; asci up to 218 μm long, abruptly contracted below into short, stalk-like base . . . . *P. nepalensis*
4. Apothecia salmon to orange; asci up to 260 μm long, tapering at the base 5

5. Ascospores up to 15 μm in diameter . . . *P. orichalcea*
5. Ascospores 14-18.6 μm in diameter . . . . *Pulvinula* taxonomic sp. II

6. Ascospores 16.4-18.8 μm in diameter; paraphyses regularly branched at their apices . . . . *P. convexella*
6. Ascospores smaller; paraphyses branched or unbranched 7

7. Ascospores 11-14 μm in diameter; paraphyses often branched . . . . *P. laeterubra*
7. Ascospores 9-11.5 μm in diameter; paraphyses unbranched . . . . *P. mussooriensis*

ACKNOWLEDGEMENTS

I am deeply indebted to Prof. Donald H. Pfister, Farlow Herbarium, U.S.A. for carefully checking this manuscript, loaning some specimens of

Pulvinula, and for all his valued suggestions leading to the completion of this manuscript. I wish to thank Prof. Richard P. Korf for the loan of specimens from CUP. To Prof. K. S. Thind, my revered teacher, I am very grateful for constant encouragement and for his permission to study the collections at PAN. The research was financed by Department of Science and Technology, Government of India.

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ISOLATION AND IDENTIFICATION OF EUTYPA ARMENIACAE FROM DISEASED GRAPEVINES IN WASHINGTON STATE

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SUMMARY

Eutypa armeniacae is reported in Washington state from diseased grapevines that exhibit symptoms typical of *Eutypa* dieback. The teleomorph was not found. The fungus was identified on the basis of host symptomatology, formation of a *Cytosporina* state in culture, and pathogenicity on apricot. Problems in the taxonomy and identification of *E. armeniacae* are discussed.

Eutypa armeniacae Hansf. & Carter *ex* Carter (anamorph: *Cytosporina* sp.) (Pyrenomycetes, Sphaeriales, Diatrypaceae) causes cankers and diebacks on grapevine, *Vitis vinifera* L. and *V. labrusca* L. (Moller and Kasimatis, 1978), and apricot, *Prunus armeniaca* L. (Carter, 1957) and has been reported from a number of other woody plants. The fungus ranks as a major pathogen of both grapevines and apricots, and occurs throughout the world. Unfortunately, identification of this fungus is difficult. There is no monographic treatment of *Eutypa*, and taxonomic literature on the genus is scattered and often inaccessible. In addition, the type description of *E. armeniacae* (Carter, 1957) does not clearly differentiate it from a number of older *Eutypa* species, including *E. acharii* Tul., *E. lata* (Pers. : Fr.) Tul., and *E. ludibunda* Sacc. (Saccardo, 1882). Thus, the distinctions between *E. armeniacae* and some other species are unclear. Another difficulty is that the teleomorph of *E. armeniacae* is not known to form on natural substrata in regions receiving less than approximately 33 cm of annual rainfall, or in artificial culture (Carter, 1957). Consequently, in dry regions *E. armeniacae* must be identified on cultural and anamorphic characters without reference to teleomorphic characters. Although the *Cytosporina* state forms in culture, the lack of available information on *Cytosporina* states of other species of Diatrypaceae prevents confident identification of *E. armeniacae* solely on the morphology of its anamorph. Thus, in addition to cultural studies, previous investigations have used its pathogenicity on apricot to help differentiate *E. armeniacae* from other *Eutypa* or *Cytosporina* species (Carter *et al*., 1964; Dingley, 1960; English and Davis, 1965; Moller, 1964; Moller *et al*., 1968; Moller *et al*., 1971; Uyemoto *et al*., 1976).

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The difficulties in identifying *E. armeniacae* have often impeded research on the diseases caused by it. Such has been the case in Washington state, where in 1975 (Mink, 1975) a grapevine disease resembling *Eutypa* dieback was reported from the semi-arid Yakima Valley, which receives approximately 18 cm of annual rainfall (Anonymous, 1978). Attempts to find the teleomorph of *E. armeniacae* failed, and although some fungi isolated from the vines resembled *E. armeniacae* in cultural characteristics, they did not sporulate and were not identified (Mink, 1975).

This paper reports the results of subsequent efforts to identify *E. armeniacae* isolates from diseased grapevines in Washington. Identification of *E. armeniacae* in this study was based on: 1) symptomatology on grapevine; 2) production of a *Cytosporina* state in culture; 3) pathogenicity on apricot. Problems in the taxonomy and identification of *E. armeniacae* are discussed, and etiology of *Eutypa* dieback of grapevine in Washington is discussed in relation to identification of the fungus.

MATERIALS AND METHODS

Vineyard observations. Twenty-four 10-yr old or older 'Concord' (*Vitis labrusca*) vineyards in the Yakima Valley of Washington state were surveyed in late May and early June, 1976-1978 for presence of the disease. Disease incidence was estimated in five vineyards by randomly choosing a vineyard block in each that contained 600-1800 vines, and examining each vine for foliar and trunk symptoms. The same vineyard blocks were examined each year.

Isolation and cultural techniques. Diseased wood was excised from canker margins on 60 grapevines and stored at 4C until isolations were made. Pieces of wood approximately 0.5 cm square were surface-sterilized 30-90 sec in 1.62% sodium hypochlorite, and placed on several media, including potato-dextrose agar (PDA), PDA acidified by adding one drop of lactic acid per 9-cm-diam Petri plate, and PDA containing 200 ppm streptomycin sulfate and 50 ppm tetracycline. Isolates obtained in this manner were transferred to 9-cm-diam plastic Petri plates containing 30 ml PDA and incubated either in darkness or on a laboratory bench where they were subject to fluorescent room lighting. Ambient temperatures during incubation ranged from 20-28C. Two known isolates of *E. armeniacae* from California, no. 590 (isolated from apricot, *Prunus armeniaca*) and no. 1090 (isolated from grapevine, *Vitis vinifera*), were cultured under the same conditions for comparison.

Pathogenicity tests. Tests were conducted on apricot to assess the pathogenicity of two suspected *E. armeniacae* isolates from Washington grapevines; these tests also included known *E. armeniacae* isolates no. 590 and no. 1090 from California for comparison. The Washington isolates were no. 261, isolated from a diseased grapevine near Sunnyside, Yakima Co., June, 1976, and no. 783, isolated from a diseased grapevine near Grandview, Yakima Co., June, 1977. The pathogenicity tests were conducted at Davis, CA, and at Prosser, WA. 'Tilton' apricot trees were utilized at Davis. Because varietal trees were unavailable at Prosser, apricot trees that had been started from seed by Dr. T. Toyama were used there; parentage of the Prosser trees is unknown. Inoculum consisted of discs of mycelium cut from PDA plates; inoculum in control treatments consisted of sterile PDA discs. Inoculations were made by pruning off lateral branches 1.0-1.5 cm diam, and placing inoculum on the wounds. The inoculation points were then wrapped with aluminum foil to prevent rapid desiccation. Test results were evaluated by splitting inoculated branches longitudinally and measuring the total lengths of xylem discoloration in both directions from the inoculation points. The fungi were reisolated as before. Five trees were inoculated with each of the five treatments (four isolates and control) in the Prosser test, and four trees with each treatment in the Davis test. The Prosser test ran from May 16-October 13, 1980, and the Davis test ran from May 28-November 21, 1980.

RESULTS

Vineyard observations. The disease was found in each of the 24 vineyards. Disease incidence in the five selected vineyards ranged from 20-84%, and did not change significantly during 1976-1978.

Foliar symptoms were most evident in late May when new shoots were three or four internodes long. Symptoms became more difficult to detect as the season progressed because diseased foliage tended to be obscured by healthy shoots. Diseased leaves were stunted, chlorotic, and cupulate. Internodes were shortened and the berries tended to fall from affected shoots. Terminals of severely diseased vines often collapsed and died during hot weather; new shoots often developed below the diebacks the following spring. Unlike healthy vines, diseased vines usually suckered profusely.

Diseased vines also had trunk cankers associated with large pruning wounds that measured 5-8 cm in diameter and had been made during the mid-1960's when trellises were changed from four-arm Kniffen trellises to two-arm trellises. Smaller wounds caused by normal pruning operations were seldom associated with cankers. Cankers occasionally were evinced by concentric peripheral ridges resulting from growth of adjacent healthy tissue, but usually were inconspicuous unless covering bark was stripped away to reveal the dark-brown-discolored wood typical of the cankers. The discolored wood usually extended below ground on vines with severe foliar symptoms. Vines died when cankers girdled their trunks.

A *Cytosporina* state resembling that of *E. armeniacae* was found on the canker of one diseased vine near Prosser, WA in June, 1977. The teleomorph was never observed.

Isolations and cultural observations. A fungus which formed a *Cytosporina* state in culture was isolated from 50 of 60 randomly chosen diseased vines. Colonies were initially hyaline with cottony aerial growth and diffuse margins. After 2-4 wk, regions of dark gray to black aerial hyphae developed. Isolates differed in the extent and intensity of the dark mycelial regions. Pale yellow conidial masses began exuding from black, 1-mm-diam, subconical pycnidia after 4-6 wk. Conidia were 34-74 (-78) x 1-1.5 (-2) μm, single-celled, moderately curved, filiform, and

Table 1. Pathogenicity of four isolates of Eutypa armeniacae on apricot (Prunus armeniaca) at Davis, CA and Prosser, WA.

Isolate	Ave. Length Internal Discoloration (Cm)[x] Davis	Prosser
Control	4.1 a	1.0 a
261[y]	17.8 b	2.7 ab
1090[z]	30.0 c	3.3 ab
783[y]	34.0 c	4.1 b
590[z]	44.8 d	7.0 c

[x] Values within columns followed by the same letter are not significantly different from each other (P = 0.05) according to Duncan's new multiple range test.

[y] Washington isolate.

[z] California isolate.

hyaline. Reverse sides of month-old colonies were creamy white to pale yellow. Cultural characteristics of the known E. armeniacae isolates from California were identical to Washington isolates while the colonies were expanding, but sporulating cultures (4-6 wk old) differed in several respects. The California isolates did not become as dark as Washington isolates, tended to produce more pycnidia with larger spore masses and smaller conidia that measured (15-) 25-35 (-39) x 1-2 µm, and discolored the culture medium a more intense yellow. Neither the Washington nor the California isolates sporulated in darkness.

Pathogenicity tests. Results of pathogenicity tests of two suspected isolates of E. armeniacae from Washington grapevines and two known E. armeniacae isolates from California are presented in Table 1. All four isolates were pathogenic in the Davis test. At Prosser, isolates no. 590 and no. 783 were pathogenic, but isolates no. 261 and no. 1090 did not differ significantly from the control treatment. Xylem discoloration extending from wounds inoculated with isolate no. 590 was significantly greater than that produced by other isolates in both tests.

DISCUSSION

This report is one of several (Carter *et al.*, 1964; English and Davis, 1965; Kouyeas *et al.*, 1978; Kouyeas *et al.*, 1976) in which the teleomorph of *E. armeniacae* was not found on the host from which the fungus was reported. Identification of *E. armeniacae* in the absence of its teleomorph under natural conditions is complicated by its inability to form the teleomorph in artificial culture. It is further complicated by a general lack of information on *Cytosporina* states which might be confused with the *Cytosporina* state of *E. armeniacae*. Previous studies on *E. armeniacae* have used its pathogenicity on apricot and behavior in culture to help distinguish it from other fungi (Carter *et al.*, 1964; Dingley, 1960; English and Davis, 1965; Moller, 1964; Moller *et al.*, 1968; Moller *et al.*, 1971; Uyemoto *et al.*, 1976). Consequently, the following three criteria were used to identify *E. armeniacae* in this study:

1) Consistent isolation of the fungus from diseased vines exhibiting symptoms identical to those caused by *E. armeniacae* in other areas (e.g., Moller and Kasimatis, 1978). Disease symptoms included stunted and deformed chlorotic foliage, dieback, and trunk cankers associated with pruning wounds. These symptoms are, insofar as is known, unique to *Eutypa* dieback.

2) Production of a *Cytosporina* state in artificial culture when exposed to light. Although some other species of Diatrypaceae sporulate in darkness (Glawe, unpublished), *E. armeniacae* does not. Conidia of Washington isolates are larger than the size range reported in the type description (Carter, 1957) and found in the known *E. armeniacae* isolates examined in this study. However, R. C. Pearson (personal communication) reports that ascospore isolates from grapevines in New York produce conidia that are similar in size to Washington isolates. Thus, it appears that the original description of *E. armeniacae* does not indicate the full size range of conidia formed by this species.

3) Pathogenicity on apricot. Apricots were used in this, as well as in previous studies (Carter *et al.*, 1964; Dingley, 1960; English and Davis, 1965; Moller, 1964; Moller *et al.*, 1966; Moller *et al.*, 1968; Moller *et al.*, 1971; Uyemoto *et al.*, 1976) to verify pathogenicity of isolates from diseased grapevines. Apricots are preferred in pathogenicity tests for purposes of identification because symptoms develop in months rather than years as is required on grapevines (Moller and Kasimatis, 1978). Both the known

isolates (no. 590 and no. 1090) and the suspect isolates (no. 261 and no. 783) were pathogenic in the Davis test. In the Prosser test, isolates no. 590 and no. 783 were pathogenic, but isolates no. 261 and no. 1090 did not differ significantly from the control treatment. From these results it appears that the latter isolates were less virulent, and might have become differentiated from the control treatment in the Prosser test had that test continued longer. Differences in virulence among *E. armeniacae* isolates have been reported previously (Ramos *et al.*, 1975a). Isolate no. 590 caused significantly more xylem discoloration than the other isolates in both tests. Discoloration of xylem was more extensive for each isolate, and in the control treatments, in the Davis test than in the Prosser test. The reason for this is unknown. The Davis test ran approximately six months and the Prosser test approximately five months, but it appears unlikely that the difference in test lengths is responsible for the four- to nine-fold differences between test results. Although no differences in varietal susceptibility to *E. armeniacae* have been reported, genetic differences among apricots might have affected the test results. Another possibility is that climatic differences between Davis and Prosser influenced the results. This possiblility is consistent with the fact that *Eutypa* dieback has not been reported on apricot in Washington or other cool areas of the world where they are grown, but is common on apricot in California and other areas with mild climates (Moller, unpublished). Further studies are necessary to clarify the factors affecting development of *Eutypa* dieback on apricot, but the pathogenicity tests in this study do demonstrate the pathogenic potential of Washington isolates on apricot.

Identification of *E. armeniacae* on the basis of host symptomatology, formation of a *Cytosporina* state in culture and pathogenicity on apricot is consistent with previous interpetations of this species (Carter *et al.*, 1964; Dingley, 1960; English and Davis, 1965; Moller, 1964; Moller *et al.*, 1966; Moller *et al.*, 1968; Moller *et al.*, 1971; Uyemoto *et al.*, 1976). However, as stated earlier herein, the type description for *E. armeniacae* (Carter, 1957) is very similar to those of a number of nomenclaturally older *Eutypa* species. The description for *E. armeniacae* (Carter, 1957) does not indicate how it may be distinguished from those species, nor have any subsequent studies addressed this problem. Thus, it is possible that *E. armeniacae* is a synonym of an older name; the name is used here in order to conform with its widespread use among plant pathologists.

Clearly, however, studies on E. armeniacae and similar Eutypa species are needed to clarify their taxonomy and nomenclature, and to simplify their identification.

The results of this study establish the presence of E. armeniacae and Eutypa dieback of grapevine in Washington. Previous investigations of Eutypa dieback in Washington (e.g., Mink, 1975) failed to elucidate its cause, apparently because fungi isolated from diseased vines were cultured in darkness and isolates of E. armeniacae escaped attention because the cultures failed to sporulate. The source of inoculum in Washington remains to be determined. Conidia of E. armeniacae are thought not to function as inoculum because attempts to germinate them have failed (Moller and Kasimatis, 1978). The teleomorph was not found in the Yakima Valley, which receives approximately 18 cm of annual rainfall (Anonymous, 1978). Areas receiving more than 33 cm of rainfall, the amount reported as necessary for formation of the teleomorph (Carter, 1957), are located 50 to 100 km to the west and southwest of the Yakima Valley (Anonymous, 1978), and contain known host species. These areas are within the 60-km range for ascospore dispersal reported in California (Ramos et al., 1975b), and the 160-km range reported in Australia (Carter, 1957). It appears, therefore, that the teleomorph of E. armeniacae might occur in these neighboring higher-rainfall areas, and that long-range ascospore dispersal may be an important feature in the biology of this fungus in Washington. Further research is needed to determine the types and sources of inoculum in Washington.

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STILBELLACEOUS FUNGI 1. *DIDYMOSTILBE*

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The genus *Didymostilbe* was established by Hennings (1902) with *D. coffeae* as the type species. Twenty-six days later *Didymostilbe* Bresadola and Saccardo was described in Saccardo (1902) and typified by *D. eichleriana*. Sydow (1903) noted this nomenclatural problem and indicated that Hennings´ name has priority.

We have examined the type material of six of the eight species presently place in *Didymostilbe*. It appears that this genus differs from *Stilbella* Lindau as lectotypified by *S. erythrocephala* (Ditmar:Fr.) Lindau solely by the presence of a septum in the mature conidia. This character is highly variable and by itself, perhaps insufficient to maintain *Didymostilbe* as a genus distinct from *Stilbella*. In the absence of a critical examination of *Stilbella*, we have retained *Didymostilbe*. A revision of the genus is presented here.

Didymostilbe P. Hennings, Hedwigia 41:148. 5 August 1902
Species Typica: *D. coffeae* P. Henn.

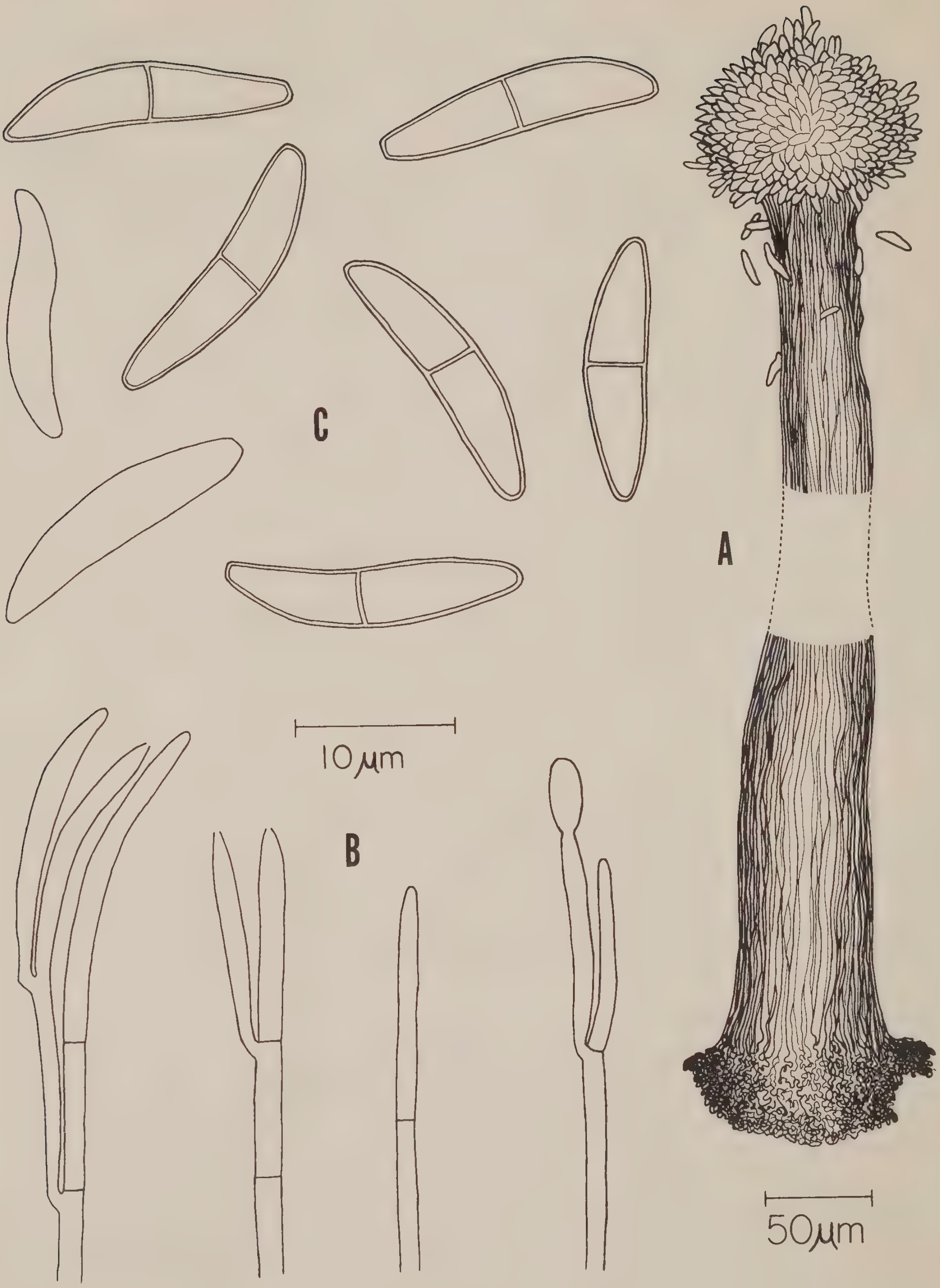

Figure 1, A-C. Didymostilbe coffeae. A. Synnema; B. Conidiogenous cells; C. Mature conidia.

= Didymostilbe Bres. & Sacc.,
Compt. Rend. Congr. Bot. Palermo 1902:59. 31 August 1902.
Species typica: D. eichleriana Bres. & Sacc.

Conidiophores macronematous, synnematous. Synnemata erect, straight, white, cream or tan, cylindrical to clavate, smooth with a mucoid head. Filaments of synnemata interwoven, hyaline, septate, monopodial, dichotomous or verticillate. Conidiogenous cells enteroblastic phialidic, integrated or discrete, terminal or lateral, hyaline, smooth-walled, cylindrical. Phialoconidia acrogenous, hyaline, 1-septate.

Key to the Species of Didymostilbe Henn.*

1. Conidiogenous cells < 20 µm long 2
   Conidiogenous cells > 20 µm long 3
2. Conidia 2.2-4.4 µm wide .... D. ellisii
   Conidia 4.2-6.6 µm wide .... D. coprophila (2)
3. Conidia < 10 µm long .... D. kamatii (3)
   Conidia > 10 µm long 4
4. Conidia fusoid .... D. coffeae
   Conidia obovoid .... D. eichleriana

*Numbers in parentheses refer to literature cited.

Didymostilbe coffeae P. Henn. Figure 1, A-C.
Hedwigia 41:148. 5 August 1902.

Mycelium immersed in the substrate, composed of branched, septate, subhyaline or light brown hyphae. Conidiophores macronematous, synnematous. Synnemata erect, straight cream or tan-brown, cylindrical, smooth, with a mucoid head, up to 880 µm high, 60-110 m wide at the base. Filaments of synnemata interwoven, slender, hyaline, monopodial or with dichotomous branching at the apex. Conidiogenous cells enteroblastic phialidic, integrated or discrete, terminal or lateral, cylindrical, hyaline, smooth-walled, 29-35 x 3.5-4.0 µm. Collarettes poorly developed or lacking. Phialoconidia acrogenous, hyaline, smooth, fusoid, straight or slightly allantoid, 1-septate at maturity, 16.5-20.6 x 3.0 4.0 µm.

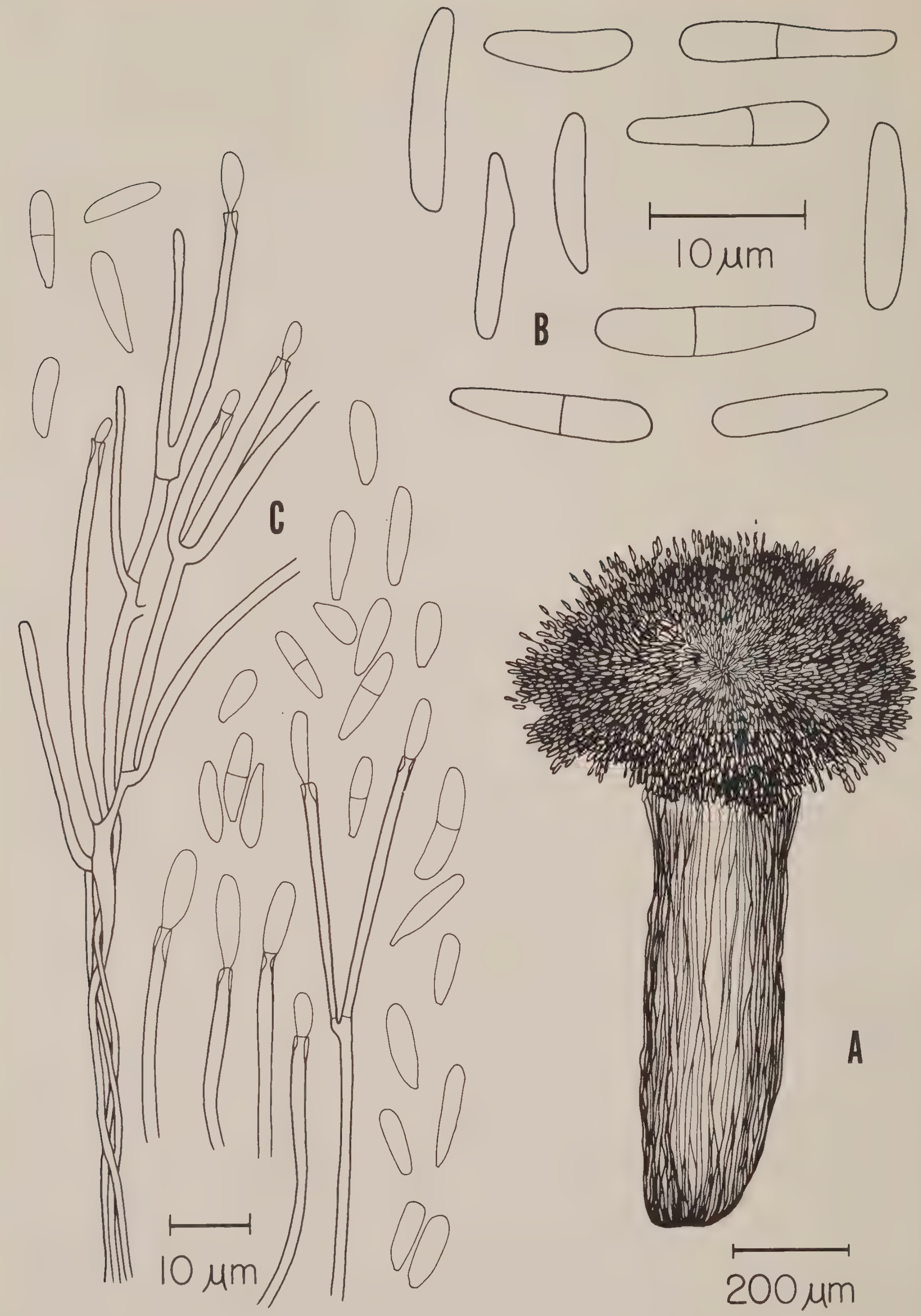

Figure 2, A-C. Didymostilbe eichleriana. A. Synnema; B. Conidia; C. Conidiogenous cells and conidia.

Etymology: After the host genus Coffea.

Type: Auf Zweigen von Coffea arabica L. Buitenzorg [Bogor}, Java, A. Zimmermann, (B).

Other Material Examined: On Coffea sp., Camargo Chih, Mexico, 28 April 1967, H. R. Conway. Intercepted at El Paso, No. 68952 (BPI).

Didymostilbe eichleriana Bres. & Sacc. Figure 2, A-C. Compt. Rend. Congr. Botan. Palermo 1902:59. 31 August 1902.

= Didymostilbe obovoidea Matsushima, Icones microfungorum a Matsushima lectorum: 60. 1975.

Mycelium immersed in the substrate, composed of branched, septate, hyaline hyphae. Conidiophores macronematous, synnematous. Synnemata erect, straight, white to cream colored, cylindrical to clavate, smooth with mucoid, tan-brown heads, 500-750 x 120-130 µm. Filaments of synnemata interwoven, slender, hyaline with monopodial, dichotomous or verticillate branching at apex. Conidiogenous cells enteroblastic, phialidic, discrete, terminal or lateral, cylindrical, hyaline, smooth-walled, with a collarette, 25-50 (-55) x 1.2-2.2 µm. Phialoconidia acrogenous, collecting in tan-brown droplets, obovoid, hyaline, smooth, 1-septate at maturity, (8.9-) 11.0-15.0 x 2.2-3.5 µm.

Etymology: Honoring the collector, B. Eichler.

Type: Supra algas vivas in truncis Betulae albae in Polonia rossica, B. Eichler, (PAD).

Didymostilbe ellisii Saxena & Mukerji Figure 3, A-E. Trans. Brit. Mycol Soc. 55:503. 1970.

Mycelium superficial to immersed in substrate, composed of branched, septate, hyaline hyaphae. Conidiophores macronematous, synnematous. Synnemata erect, straight, white to yellow-white, smooth, cylindrical at base gradually expanding towards the apex into a spherical or subspherical head, 480-622 µm high, 35-45 µm wide at the base, 65-85 µm wide at the apex. Filaments of synnemata hyaline, septate, parallel at the base, divergent at the apex, simple or once or twice branched. Conidiogenous cells enteroblastic, phialidic, integrated or discrete, terminal or lateral, hyaline, smooth-walled, cylindrical to somewhat flask-shaped, 9-14 x 2.2-3.3 µm. Phialoconidia formed in basipetal chains, oblong to fusoid, occasionally curved, hyaline, thick-walled, 1-septate at maturity, not constricted, 13-23 x 2.2-4.4 µm.

Etymology: Honoring M. B. Ellis.

Type: On rabbit dung, Delhi, India, April 1969, Leg. A. S. Saxena, DU/KS100,1M1(143075).

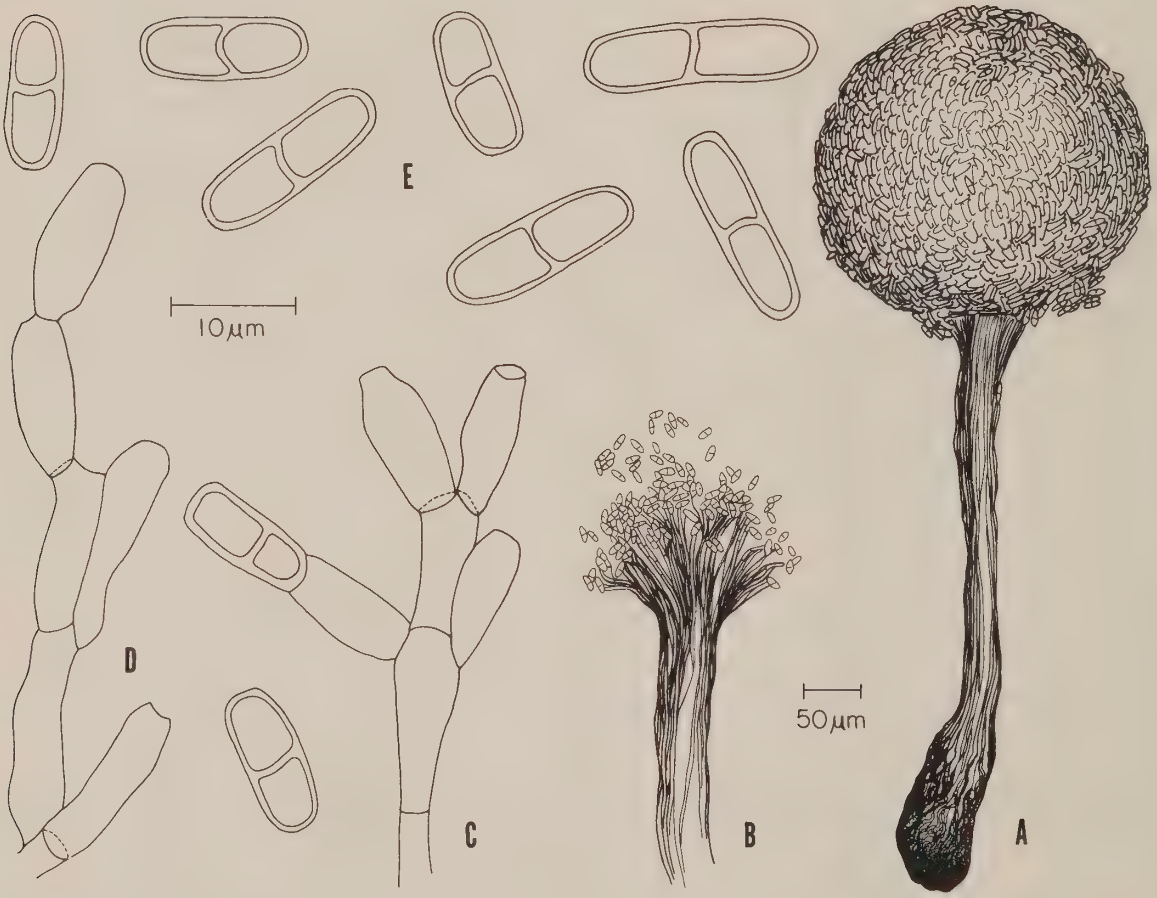

Figure 3, A-C. Didymostilbe ellisii. A & B. Synnemata; C. & D. Conidiophores, conidiogenous cells and conidia; E. Mature conidia.

Nomina Excludendae

Didymostilbe coprophila Mirza & Qureshi, Trans. Brit. Mycol Soc. 54: 148. 1970. Type material not seen.

Didymostilbe kamatii Pawar & Kulkarni, Current Science 41:73-74. 1972. (AMH!) No fertile heads remain on type specimen.

Didymostilbe capillaceae Sacc. & Bres., Annales Mycologici 1:28. 1903. (PAD!) No ferile heads remain on type specimen.

Didymostilbe coccinea (Massee) Saccardo, Syll. Fung. 22(2): 1446. 1913.

Basionym: *Hartiella coccinea* Massee, Kew Bulletin 1910:5. 1910. (K!)

= *Calostilbella calostilbe* v. Hohnel.

Didymostilbe obovoidea Matsushima, Icones microfungorum at Matsushima lectorum: 60. 1975. Type material not seen. From the description and illustrations, it appears identical with *D. eichleriana* except for the width of the synnemata.

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VARIABILITY OF SPORES OF DIFFERENT BASIDIOCARPS GROWING ON THE SAME MYCELIUM IN THE APHYLLOPHORALES

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The dimensions of basidiospores are one of the most important characters for distinguishing closely related species of the Aphyllophorales. However, there are many obstacles to reliable use of such characteristics. Firstly, for most fungal species, including the Aphyllophorales, we do not have available spore measurements representing the entire species but only for some, possibly unrepresentative, specimens. Thus most descriptions of new species include measurements of the spores of the type specimen only, and few descriptions include such measurements for a local population. In monographs and keys the absolute range of spore dimensions is given; in most cases neither the number of spores measured nor the origin of the specimens studied is indicated. In too many cases exactly the same dimensions are given in different text-books where fungi of remote areas are described, which does not inspire confidence in such data.

Most contemporary taxonomists accept the biological concept of the species and the rightness of the population approach to species studies. Proceeding from this point of view, a species is distinguished not by the spore characteristics of the holotype specimen but by those of different specimens of different populations of species. Like all other phenotypic characters, the spore measurements are variable within certain limits, typical for the species. This variability is complicated and includes several components: variability of populations within the species, variability of specimens, variability of one specimen during the spore discharge season (dependent and/or independent of environmental factors, especially weather conditions), diurnal variability, and variability of individual spores in a spore print obtained within a short period of time from one specimen.

In the Agaricales the variability of spores has been studied by several authors in a reasonable number of species (see Clemençon, 1979) but in the Aphyllophorales only in a small number of species. Some less well-known papers on the subject include the following.

E. Parmasto & I. Parmasto (1976) studied a local population of *Polyporus rhizophilus* Pat. in Central Asia (USSR). Differences between the mean spore lengths of some specimens was statistically highly significant, the range of means being 7.54-8.73 µm.

K. Bjørnekaer (1938) demonstrated that the mean length of the spores of the same basidiocarp of *Fomes fomentarius* (Fr.) Fr. varied from 21.0 µm on 11 May to 13.3 µm on 27 September, 1931, and from 20.7 µm on 19 April to 14.0 µm in September-November, 1932.

I. Nuss (1975) found that in seven species out of the 27 species he studied the form and/or dimensions of spores changed statistically very significantly during the sporulation period. In the same paper data were given on the mean spore measurements of different specimens of one local community.

I. Parmasto & E. Parmasto (1977) studied the variability of spore dimensions during the discharge period in three species of *Phellinus* in Estonia (USSR) and found the difference between the mean spore lengths to be statistically significant in *Ph. alni* (Bond.) Parm., *Ph. populicola* Niemelä and in three specimens of *Ph. igniarius* (Fr.) Quél. The difference was insignificant in three specimens of *Ph. igniarius*.

However, there is a further source of possible variability not accounted for in the above investigations, and which has been virtually unstudied in the Aphyllophorales, i. e. the differences which may occur between spores of different basidiocarps originating from the same mycelium. This variability is not only of taxonomic interest for it may also reflect the genetical diversity of different parts of an individual mycelium. So far as we are aware, this kind of variability has been studied only by R. Agerer (1975) in two groups of basidiocarps of *Flagelloscypha minutissima* (Burt) Donk and *F. kavinae* (Pil.) W.B. Cooke.

MATERIALS AND METHODS

Spores of 37 pairs, nine sets of three and one set of four basidiocarps of eight different species growing in nature were collected. Each set was believed to originate from the same mycelium: as a rule, members of the same set were growing not more than 15-25 cm from each other, and in some cases they had coalesced. Spore samples were collected from each basidiocarp as spore prints, shed over a 24 h period.

For four *Coriolus* species, herbarium material was used, each collection consisting of 5-6 individual basidiocarps which had been collected as presumably growing from the same mycelium.

From every sample 30 spores were measured in 2 % KOH solutiom using an eyepiece micrometer at a magnification of x 700 under the microscope МБИ-6, and the data were compared using Student's *t*-test.

RESULTS

Of the 36 pairs of basidiocarps, the difference in spore length was statistically insignificant (at $P > 0.10$) in 23 cases, significant (at $P < 0.05$) in seven cases and statistically highly significant (at $P < 0.001$) in six cases (Table 1). Amongst the species studied there were some pairs of basidiocarps with a significant difference in spore length except *Fomes fomentarius*, *Phellinus pini* (only one pair studied) and *Ph. populicola* (three pairs studied).

Of the nine sets of three and four basidiocarps (Table 2), the difference in spore length was in only two cases statistically insignificant between all the basidiocarps belonging to one set. In two cases (i. e. *Phellinus alni* and *Ph. nigricans*) all three basidiocarps significantly differed from each other in their mean spore length; and in the remaining sets (altogether six) two basidiocarps had similar spores and the third had statistically different ones. In the one set of four there were two different pairs of basidiocarps with similar spores.

In all four sets of basidiocarps of *Coriolus* spp. (*C. hirsutus*, *C. pubescens*, *C. versicolor* and *C. zonatus*) there were some pilei with similar spores and some with significantly different ones (Table 3).

Table 1

DIFFERENCE BETWEEN SPORES IN PAIRS OF BASIDIOCARPS[a]

Species, locality, substrate, date	Mean length (μm) ± s.e.	*t*	*Q* ± s.e.	*t*
Fomes fomentarius (Fr.) Fr				
Eston. SSR, on Betula sp., V.69	17.30 ± 0.21 17.34 ± 0.20	0.1	3.16 ± 0.06 2.96 ± 0.04	2.8*
Phellinus alni (Bond.) Parm.				
Eston. SSR, on Alnus incana, 15.X.69	6.47 ± 0.06 7.19 ± 0.13	5.1***	1.12 ± 0.02 1.08 ± 0.02	1.5
Eston. SSR, on Malus domestica, 24.VIII.70 [b]	6.31 ± 0.09 6.71 ± 0.06	3.9***	1.08 ± 0.01 1.10 ± 0.02	0.9
Eston. SSR, on Sorbus aucuparia, 16.X.70	5.64 ± 0.07 5.81 ± 0.09	1.5	1.07 ± 0.02 1.06 ± 0.01	0.5

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[a] Significance of difference: * - significant at $P < 0.05$; ** - at $P < 0.01$; *** - at $P < 0.001$. *Q* - mean ratio of spore length and width.

[b] Basidiocarps grown together to each other.

Table 1 (continued)

Species, locality, substrate, time	Mean length (µm) ± s.e.	*t*	*Q* ± s.e.	*t*
Phellinus alni				
Eston. SSR, on Alnus incana, 15.X.69	6.29 ± 0.05	1.3	1.08 ± 0.02	2.0*
	6.40 ± 0.06		1.13 ± 0.02	
Eston. SSR, on Padus racemosa, 3.VI.69	6.06 ± 0.06	1.2	1.12 ± 0.02	0.7
	6.18 ± 0.08		1.10 ± 0.02	
- the same, 15.X.69	6.15 ± 0.07	2.3*	1.10 ± 0.02	0.4
	5.91 ± 0.07		1.09 ± 0.02	
Eston. SSR, on Sorbus aucuparia, 16.X.70	6.84 ± 0.09	1.1	1.09 ± 0.01	1.3
	6.96 ± 0.06		1.11 ± 0.01	
Eston. SSR, on Malus domestica, 13.V.71	5.61 ± 0.06	1.0	1.12 ± 0.02	0.9
	5.70 ± 0.07		1.14 ± 0.02	
Eston. SSR, on Sorbus aucuparia, 7.X.69	6.00 ± 0.09	0.1	1.11 ± 0.02	1.1
	6.01 ± 0.08		1.14 ± 0.02	
Ph. hartigii (All. & Schn.) Pat.				
Sakhalin, on Abies sachalinensis, 23.VIII.71	7.70 ± 0.09	5.4***	1.06 ± 0.01	0.7
	8.27 ± 0.05		1.05 ± 0.01	
Lvov Reg., on Abies alba, 21.IX.69	7.96 ± 0.08	1.2	1.05 ± 0.01	0.9
	8.10 ± 0.08		1.04 ± 0.01	
Lvov Reg., on Abies alba, 21.IX.69	8.03 ± 0.07	0.6	1.04 ± 0.01	0
	8.09 ± 0.06		1.04 ± 0.01	
Sakhalin, on Abies sachalinensis, 23.VIII.74	7.36 ± 0.09	0.4	1.06 ± 0.01	0
	7.41 ± 0.10		1.06 ± 0.01	
Caucas. Nature Reserve, on Abies nordmanniana, 23.V.75	8.07 ± 0.07	0.3	1.06 ± 0.01	1.2
	8.11 ± 0.10		1.08 ± 0.01	
Ph. igniarius (Fr.) Quél.				
Eston. SSR, on Salix caprea, 14.V.69	5.93 ± 0.07	4.6***	1.11 ± 0.02	0.6
	6.38 ± 0.06		1.10 ± 0.01	
- the same, 27.V.69	5.84 ± 0.06	4.2***	1.13 ± 0.01	1.5
	6.20 ± 0.06		1.11 ± 0.01	
Krasnojarsk Reg., on Salix sp., 28.VIII.71	5.62 ± 0.07	3.1*	1.12 ± 0.01	1.0
	5.92 ± 0.06		1.13 ± 0.01	
Eston. SSR, on Salix pentandra, 12.VI.69	6.08 ± 0.07	2.9*	1.09 ± 0.01	3.0*
	6.34 ± 0.06		1.15 ± 0.02	
Eston. SSR, on Salix triandra, 15.X.69	5.95 ± 0.08	2.6*	1.13 ± 0.02	0.7
	6.27 ± 0.09		1.15 ± 0.02	
Kamchatka, on Salix sachalinensis, 13.VIII.71	5.54 ± 0.07	1.1	1.09 ± 0.02	1.9
	5.64 ± 0.06		1.13 ± 0.02	
Eston. SSR, on Salix caprea, 7.VIII.69	5.48 ± 0.07	0.9	1.12 ± 0.03	0.6
	5.58 ± 0.09		1.13 ± 0.02	

Table 1 (continued)

Species, locality, substrate, time	Mean length (um) ± s.e.	*t*	*Q* ± s.e.	*t*
Phellinus nigricans (Fr.) P. Karst.				
Eston. SSR, on Betula pendula, 7.X.69	6.78 ± 0.07 7.27 ± 0.09	4.3***	1.09 ± 0.02 1.09 ± 0.02	0
Krasnojarsk Reg., on Betula pendula, 28.VIII.71	6.56 ± 0.03 6.73 ± 0.05	2.8*	1.06 ± 0.01 1.08 ± 0.01	1.2
Kamchatka, on Betula ermanii, 13.VIII.71	6.76 ± 0.06 6.95 ± 0.05	2.4*	1.07 ± 0.01 1.08 ± 0.01	0.8
Sweden, Tärna, 6.IX.74	6.36 ± 0.06 6.55 ± 0.06	2.2*	1.08 ± 0.01 1.12 ± 0.02	2.1*
Belovezhskaja Pushcha Nature Reserve, on Betula pendula, 24.IX.69	6.64 ± 0.08 6.79 ± 0.07	1.5	1.11 ± 0.01 1.12 ± 0.01	0.4
Kamchatka, on Betula ermanii, 13.VIII.71	6.62 ± 0.06 6.71 ± 0.07	1.1	1.07 ± 0.01 1.09 ± 0.02	1.1
Eston. SSR, on Betula pendula, 7.X.69	6.66 ± 0.08 6.77 ± 0.08	0.9	1.12 ± 0.02 1.10 ± 0.02	0.9
Eston. SSR, on Betula pendula, 7.X.69	7.06 ± 0.10 7.10 ± 0.08	0.3	1.12 ± 0.03 1.12 ± 0.02	0
Kamchatka, on Betula ermanii, 17.VIII.71	6.67 ± 0.06 6.67 ± 0.06	0	1.06 ± 0.01 1.06 ± 0.01	0
Ph. pini (Fr.) A. Ames				
Krasnojarsk Reg., on Pinus sylvestris, 28.VIII.71	5.30 ± 0.06 5.35 ± 0.05	0.6	1.11 ± 0.01 1.11 ± 0.01	0
Ph. populicola Niemelä				
Belovezhskaja Pushcha, on Populus tremula, 24.IX.69	5.32 ± 0.09 5.40 ± 0.07	0.7	1.18 ± 0.05 1.21 ± 0.02	0.5
Eston. SSR, on Populus tremula, 14.VI.69	5.11 ± 0.04 5.15 ± 0.05	0.6	1.09 ± 0.02 1.15 ± 0.08	0.7
Belovezhskaja Pushcha Nature Reserve, on Populus tremula, 24.IX.69	5.00 ± 0.08 5.05 ± 0.07	0.4	1.18 ± 0.02 1.19 ± 0.02	0
Ph. tremulae (Bond.) Bond. & Boriss.				
Krasnojarsk Reg., on Populus tremula, 28.VIII.71	5.07 ± 0.07 5.75 ± 0.06	7.5***	1.18 ± 0.02 1.21 ± 0.01	1.5
Eston. SSR, on Populus tremula, 7.X.69	5.42 ± 0.08 5.69 ± 0.08	2.5*	1.13 ± 0.02 1.17 ± 0.02	1.3
Caucasian Nat. Reserve, on Populus tremula, 23.V.75	5.38 ± 0.05 5.44 ± 0.05	1.0	1.17 ± 0.02 1.14 ± 0.01	1.8

Table 2

DIFFERENCE BETWEEN SPORES IN SETS OF THREE OR FOUR BASIDIOCARPS

Species, locality, substrate, date	Mean length (µm) ± s.e.	t^1 / t^2	Q ± s.e.	t
Phellinus alni				
Eston. SSR, on Malus domestica, 1.IX.70	5.16 ± 0.07	1.7	1.08 ± 0.02	0
	5.36 ± 0.10	6.0***	1.08 ± 0.02	4.1**
	6.02 ± 0.05	13.2***	1.16 ± 0.01	3.8**
Eston. SSR, on Sorbus aucuparia, 16.X.70	5.88 ± 0.08	1.1	1.08 ± 0.01	0
	5.99 ± 0.07	3.1**	1.08 ± 0.01	0.6
	5.70 ± 0.07		1.07 ± 0.01	
Eston. SSR, on Padus racemosa, 17.IX.70	5.66 ± 0.06	1.4	1.12 ± 0.01	1.4
	5.54 ± 0.07	3.0**	1.09 ± 0.02	2.3*
	5.87 ± 0.08		1.08 ± 0.01	2.3*
Eston. SSR, on Sorbus aucuparia, 16.X.71	5.79 ± 0.06	1.8	1.07 ± 0.01	0.6
	5.63 ± 0.07	2.5*	1.08 ± 0.01	0
	5.87 ± 0.07	1.8	1.08 ± 0.01	0
	5.68 ± 0.08		1.08 ± 0.02	
Phellinus igniarius				
Eston. SSR, on Salix triandra, 15.X.69	6.26 ± 0.07	0.1	1.16 ± 0.02	2.0*
	6.25 ± 0.08	4.5***	1.10 ± 0.02	1.4
	6.78 ± 0.09		1.14 ± 0.02	
Eston. SSR, on Salix pentandra, 12.VI.69	5.85 ± 0.08	1.4	1.11 ± 0.01	
	6.01 ± 0.09	2.3*	1.22 ± 0.02	
	6.25 ± 0.06	4.1***	1.12 ± 0.01	
Eston. SSR, on Salix caprea, 14.VI.69	6.08 ± 0.08	0	1.19 ± 0.08	0.9
	6.08 ± 0.06	4.1***	1.12 ± 0.02	2.2*
	6.39 ± 0.04		1.16 ± 0.01	
Eston. SSR, on Salix caprea, 16.VI.69	6.01 ± 0.09	0.2	1.12 ± 0.01	0.2
	6.03 ± 0.06	1.6	1.12 ± 0.01	3.6***
	6.19 ± 0.08		1.19 ± 0.02	
Phellinus nigricans				
Eston. SSR, on Betula pendula, 14.VI.69	6.15 ± 0.07	2.8**	1.07 ± 0.01	0.6
	6.43 ± 0.06	4.2***	1.08 ± 0.01	1.1
	6.72 ± 0.05	6.8***	1.09 ± 0.01	1.7
Phellinus populicola				
Eston. SSR, on Populus tremula, 2.X.69	5.25 ± 0.06	1.3	1.16 ± 0.01	1.9
	5.35 ± 0.05	0.3	1.10 ± 0.01	0
	5.37 ± 0.05	1.6	1.10 ± 0.01	2.0*

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t^1 - value of Student's t for the samples of two neighbouring basidiocarps; t^2 - value of t for extreme means. Significance of difference marked as in Table 1.

Table 3

DIFFERENCES BETWEEN MEAN LENGTHS OF SPORES OF DIFFERENT PILEI OF ONE HERBARIUM COLLECTION
(value of Student's *t*; significance of difference marked as in Table 1)

Coriolus hirsutus (Fr.) Quél.

Collection: TAA 111799. Estonian SSR, near Tartu, on a log of Alnus glutinosa, coll. M. Saar 20.X.1979.

Mean length ± s.e. of spores: pileus no. 1 - 5.71 ± 0.08; 2 - 5.91 ± 0.13; 3 - 6.16 ± 0.09; 4 - 6.16 ± 0.11; 5 - 6.95 ± 0.12 µm.

Pileus no.	1	2	3	4
5	8.7***	6.0***	5.3***	6.4***
4	3.4**	1.5	0	
3	3.7***	1.6		
2	1.3			

Coriolus pubescens (Fr.) Quél.

Collection: TAA 52534. Primorskij Reg., Sikhote-Alin Nature Reserve, on Salix sp., coll. E. Parmasto 11.IX.1976.

Mean length ± s.e. of spores: 1 - 5.09 ± 0.09; 2 - 5.21 ± 0.07; 3 - 5.31 ± 0.07; 4 - 5.34 ± 0.10; 5 - 5.59 ± 0.12; 6 - 5.76 ± 0.10 um.

Pileus no.	1	2	3	4	5
6	4.9***	4.4***	3.6***	3.0**	1.1
5	3.4**	2.8**	2.0*	1.6	
4	1.8	1.0	0		
3	1.9	0.9			
2	1.0				

Coriolus versicolor (Fr.) Quél.

Collection: TAA 112716. Estonian SSR, near Tartu, on a log of Betula sp., coll. A. Kollom 27.VII.1979.

Mean length ± s.e. of spores: 1 - 5.13 ± 0.08; 2 - 5.23 ± 0.07; 3 - 5.36 ± 0.08; 4 - 5.39 ± 0.08; 5 - 5.46 ± 0.09 µm.

Table 3 (continued)

Pileus no.	1.	2	3	4
5	2.8**	2.0*	0.8	0.6
4	2.3*	1.5	0.3	
3	2.0*	1.2		
2	0.9			

Coriolus zonatus (Fr.) Quél.

Collection: TAA 97422. Estonian SSR, Järvselja, on a log of Populus tremula, coll. I. Parmasto 3.XI.1978.

Mean length ± s.e. of spores: 1 - 5.43 ± 0.08; 2 - 5.48 ± 0.09; 3 - 5.64 ± 0.08; 4 - 5.73 ± 0.09; 5 - 5.86 ± 0.09 µm.

Pileus no.	1	2	3	4
5	3.5***	2.9**	1.8	1.0
4	2.4*	1.9	0.7	
3	1.8	1.3		
2	0.4			

DISCUSSION

All the pairs or sets of basidiocarps studied were collected without establishing the presence or absence of dark lines, isolating different mycelia in the wood; in most cases the substratum was a growing full-size tree, and the data were collected a long time before the papers written by A.D.M. Rayner and N.K. Todd about the significance of isolating dark lines in wood were published. The only criterion for considering the basidiocarps to belong to one specimen was their close proximity.

As demonstrated recently, in several species of the Aphyllophorales studied from this aspect this criterion is not always reliable (see below). Nevertheless, in most cases the neighbouring basidiocarps of the *Phellinus* species and *Fomes fomentarius* studied by us have spores with an insignificant difference between the mean lengths and usually also between the mean values of *Q*. This may imply that the *Phellinus* species and *Fomes fomentarius* have long-living mycelia, and the mycelium of an individual may be largely extended in the infected tree trunk or log. Indeed it has been pointed out (e. g. Williams, Todd & Rayner, 1981; Boddy & Rayner, 1982) that several fungi appear to infect standing trees as extensive single individuals, whilst ubiquitous saprophytes such as *Coriolus versicolor* and *Stereum hirsutum* (Fr.) S.F. Gray often form numerous individuals in felled timber (see below).

There are several possible explanations for the differences between the spores of other neighbouring basidiocarps:

1. The difference in the mean spore size of what is statistically significant in a technical sense does not necessarily mean that the difference is significant biologically (cf. Simpson, Roe & Lewontin, 1960: 173-175). This especially concerns the cases when the statistical significance is at the level of $P > 0.001$. As a demonstration of such a case we may indicate one pair of basidiocarps of *Phellinus alni* growing on *Padus racemosa:* the difference between the mean spore lengths was insignificant on 3 June, 1969 ($P > 0.20$), but statistically significant on 15 October of the same year ($P \approx 0.03$).

2. Different parts of the same mycelium are genetically different as a result of the fusion of genetically distinct mycelia (cf. Burnett & Partington, 1957; Bresinsky et al., 1977). However, the assumption that this phenomenon really exists under natural conditions has been disclaimed in several papers published in the last few years. (Cf. Todd & Rayner, 1980: "To date we are unaware of any convincing evidence which demonstrates effective heterocaryosis between wild dikaryotic isolates". See also Esser & Blaich, 1973 and Goldstein & Gilbertson, 1981: 177).

3. The decaying tree trunk or log is inhabited by two or several neighbouring individual mycelia of the same species, which are genetically different and which do not fuse due to their heterocaryon (somatic) incompatibility. This has been demonstrated recently in several Aphyllophorales (Rayner & Todd, 1977, 1979; Todd & Rayner, 1978, 1980; Coates, Rayner & Todd, 1981).

The last-mentioned reason seems to be acceptable for our present results. The only discrepancy which does not fit is a pair of the basidiocarps of *Phellinus alni*, which had densely coalesced but had a highly significant difference between the mean length of spores.

The difference between the mean length of spores of different pilei of one collection in the *Coriolus* species (Table 3) are easily understandable. A.D.M. Rayner and N.K. Todd (1977) have shown that many of the closely crowded basidiocarps of *Coriolus versicolor* on one tree stump belong to genetically different isolated mycelia. Obviously the same is also charactristic of *Coriolus hirsutus*, *C. pubescens* amd *C. zonatus*. The mean spore length data only are not sufficient to say exactly how many individual specimens we had in our cases mixed in one collection, but obviously there were no less than two or three.

R. Agerer (1975) compared the mean length of spores in two groups of the basidiocarps of *Flagelloscypha minutissima* and *F. kavinae*. He found that in both groups (species) there were some basidiocarps which probably belonged to different individuals, and that the groups of basidiocarps were consequently mixed populations (Mischpopulationen).

In conclusion from our study and the results of others we may assert that if not always, then in most cases the different basidiocarps of the Aphyllophorales growing on one mycelium have spores with an insignificant or small (at $P > 0.001$) differences in their mean size and form. Different specimens of one local population may have a statistically highly significant difference in spore size, and in some species having small basidiocarps they may happen to be kept in a herbarium as one collection.

ACKNOWLEDGEMENTS

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A NEW SPECIES OF ENDOPHRAGMIELLA FROM SCLEROTIA OF SCLEROTINIA MINOR

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ABSTRACT

A new dematiaceous hyphomycete, Endophragmiella constricta, isolated from sclerotia of Sclerotinia minor buried in an agricultural field in Beltsville, MD, is described and illustrated.

INTRODUCTION

An interesting fungus was observed on sclerotia of Sclerotinia minor Jagger that was used as bait in a field experiment (Adams and Ayers, 1982). This dematiaceous hyphomycete developed on sclerotia placed in moist chambers, and when isolated grew very slowly on culture media. Although this species did not show mycoparasitic ability against S. minor in vitro, it was quite unusual and is herein described as a new species of the genus Endophragmiella.

Abbreviations of herbaria follow those in the Index Herbariorum (Holmgren et al., 1981).

TAXONOMIC PART

Endophragmiella constricta Dunn sp. nov.

> Coloniae in agaro ad 21 C lente crescentes, restrictae, effusae, fuscae. Mycelium ex hyphis ramosis, septatis, brunneis, 2.0-2.3 µm crassis compositum. Conidiophora macronemata, simplicia, erecta, fusca, crassitunicata, laevia, usque ad 4 cellularia, 10.0-15.0 X 3.5 µm. Cellulae conidiogenae monoblasticae, 6.9-8.0 X 3.5 µm, cellula penultima percurrenter prolifera post conidia successiva parta, proliferae usque ad 280 µm longas. Secessio conidiarum rhexolytica, cum fimbria basali excentrica, 1.0 X 2.0 µm. Conidia fusca, crassitunicata, laevia, oblonga vel oblongo-ellipsoidea, 2-septata, 15.0-23.0 X 6.9-10.4 µm, cellula basali pallida, cellula centrali constricta.

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Isolatus e sclerotio Sclerotiniae minoris, e terra, Beltsville, Maryland, M.T. Dunn (MTD 3129). Holotypus BPI, isotypus DAOM 180189, cultura exsiccata.

Colonies on artificial media restricted, effuse, dark brown to black with little aerial mycelium, hyphae loosely branched, septate, brown, 2.0-2.3 µm wide. Conidiophores macronematous, simple, erect, rarely branched, brown, thick-walled, smooth, composed of up to 4 cells, 10.0-15.0 X 3.5 µm. Conidiogenous cells monoblastic, 6.9-8.0 X 3.5 µm, terminal on conidiophores, conidiogenous cell forming on each succesive, percurrent proliferation of the penultimate cell through the conidiogenous cell and beyond the open end that formed as a result of rhexolytic conidium secession (Figs. 2, 3, 5). As many as 29 such proliferations forming on a single conidiophore, reaching a length of up to 280 µm. Conidia retaining a portion of the conidiogenous cell as an eccentric basal frill, 1.0 X 2.0 µm. Conidia often remaining partly attached laterally to the conidiogenous cells giving the appearance of sympodial proliferation (Figs. 1, 4). Conidia brown, thick walled, smooth, oblong to oblong-ellipsoid, 2-septate, the lower cell paler, the middle cell constricted, 15.0-23.0 X 6.9-10.4 µm.

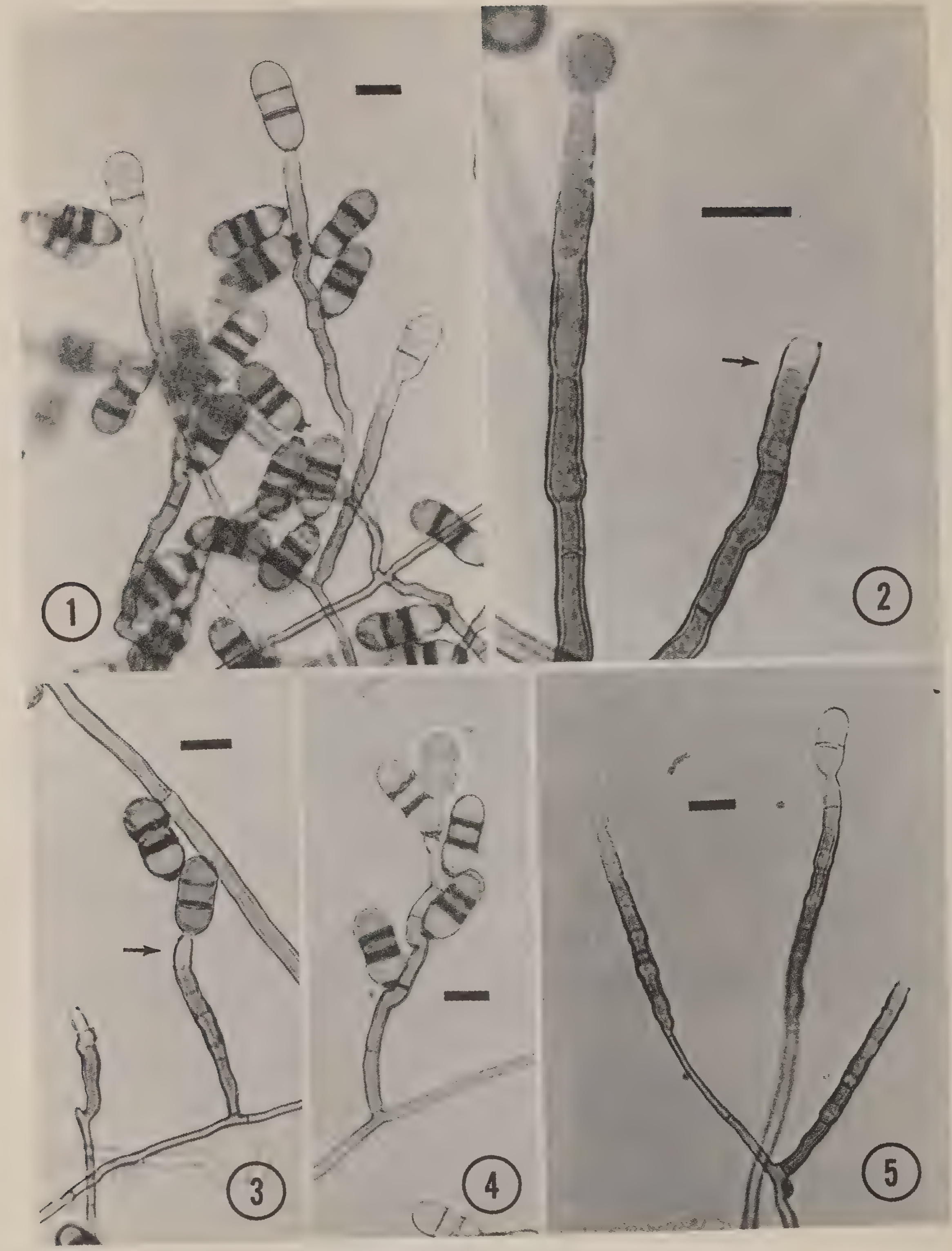
Colony growth on artificial media is very slow, attaining a diameter of only 8 mm after 24 days at 21 C on MYP, which contained 0.6% malt extract, 0.1% soytone, 0.05% yeast extract and 2% agar. Growth was faster on GYSI medium, with a colony diameter of 23 mm after 24 days. This medium contained 1% glucose, 0.05% yeast extract, 0.1% soytone, 0.001% $FeCl_3$ and 2% agar. The addition of iron to culture media has been shown to increase growth and sporulation of Sporidesmium sclerotivorum Uecker et al. [=Teratosperma sclerotivorum (Uecker, Ayers and Adams) Hughes] another dematiaceous hyphomycete associated with sclerotia of S. minor (W.A. Ayers, personal communication).

Habitat: Isolated from living sclerotia of Sclerotinia minor which had been buried in an agricultural field, Beltsville, MD.

Specimens examined: MTD 3129, June 1, 1981, dried culture in BPI (holotype) and DAOM (180189, isotype); living culture of the type deposited at ATCC 46749.

Endophragmiella constricta was isolated from a sclerotium of Sclerotinia minor Jagger during a field experiment on the ability of Teratosperma sclerotivorum to reduce lettuce drop caused by S. minor. Sclerotia were sieved from the soil and placed in petri plates with moist filter paper; E. constricta grew and sporulated on a sclerotium, and subsequently spread onto the filter paper.

Sutton (1973) first described the genus Endophragmiella to include E. pallescens and E. canadensis, both of which were hyperparasitic on carbonaceous stromata of ascomycetes. Hughes (1979) redefined



Figs. 1-5. *Endophragmiella constricta* (Bar = 10 µm). Fig. 1. Conidiophores and conidia. Fig. 2. Developing conidium and proliferation into conidiogenous cell after conidium secession (arrow). Stained with phloxine. Fig. 3. Young conidiophores showing the empty conidiogenous cell prior to conidium secession (arrow). Stained with phloxine. Fig. 4. Sympodial appearance of conidium production. Fig. 5. Young conidiophores.

the genus for species with rhexolytic conidium secession followed by a regular percurrent proliferation each arising from the cell below succesive terminal conidiogenous cells. *Endophragmiella constricta* is in the group of species with 2-septate conidia which includes *E. ontariensis* Hughes, *E. ellisii* Hughes, *E. tripartita* Hughes, *E. biseptata* (Peck) Hughes and *E. hughesii* Hawksworth. None of these species has been grown in culture (S.J. Hughes, personal communication). A recently described species, *E. fallacia* Kirk (1981), also has 2-septate conidia but they are larger than those of *E. constricta* and cylindrical. *Endophragmiella constricta* is distinct from the other species in this group in the smaller size and constricted shape of the conidia.

Endophragmiella constricta shares with other species of the genus the characteristic method of percurrent proliferation. Often the conidium remains associated with, or partially attached to, the wall of the conidiogenous cell and after several conidia have been produced, it appears as if conidia had developed sympodially (Figs. 1, 4). Kirk (1982) reported the characteristic percurrent type of proliferation in *E. corticola* Kirk but when the conidium failed to secede proliferation proceeded laterally through the wall of the conidiogenous cell. Proliferation can also appear sympodial in *E. hymenochaeticola* Hughes because the apex of the conidiogenous cell is constricted and proliferation may take place through the lateral wall instead of percurrently (Hughes, 1978).

Endophragmiella constricta has not shown any mycoparasitic ability *in vitro* against sclerotia of *S. minor*. Another dematiaceous hyphomycete recently described from sclerotia, *Arthrocristula hyphenata* Sigler, Dunn and Carmichael, apparently has no mycoparasitic ability (Sigler et al., 1982). Other dematiaceous hyphomycetes that have been isolated from sclerotia of *S. minor* with proven mycoparasitic ability include *Teratosperma sclerotivorum* (Uecker et al., 1978; Hughes, 1979) and *T. oligocladum* Uecker, Ayers and Adams (1980). These two species grow poorly on standard culture media but develop well on living sclerotia of *Sclerotinia* species. Another morphologically similar hyphomycete, *Laterispora brevirama* Uecker, Ayers and Adams (1982), was isolated from sclerotia of *S. minor* but colonized sclerotia only in association with the above mentioned *Teratosperma* spp. Evidence indicates that these three species are biotrophic parasites with facultative saprophytic ability (Ayers and Adams, 1979, 1981; Uecker et al., 1982). *Endophragmiella constricta* and *A. hyphenata* seem to be more opportunistic, possibly functioning as secondary colonizers of the sclerotia.

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THREE NEW SPECIES OF HYPOGYMNIA FROM WESTERN NORTH AMERICA (LICHENES: HYPOGYMNIACEAE)

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Abstract:--Two new species in the Hypogymnia enteromorpha group, H. heterophylla Pike and H. occidentalis Pike, and a California endemic, H. mollis Pike and Hale, are described.

Hypogymnia heterophylla Pike, sp. nov. Fig. 1b

Thallus laxe adnatus, lobis linearibus, libris, margine nigromarginatis, medulla nigra, sorediis isidiisque destitutis; apothecia numerosa; sporae ca 4 X 7 µm.

Thallus loosely attached at the base, almost subfruticose, rather soft, whitish gray, 8-15 cm broad; lobes variable, 1-4 mm wide but usually long and little branched, free and trailing, the tips often perforate, the margins conspicuously black rimmed; medullary cavity dark above and below; lower surface shiny, jet black, rugose. Pycnidia very common; microconidia rod shaped to weakly bifusiform, 5-6 µm long. Apothecia common, short stipitate, 3-15 mm in diameter, the disc dark brown, plane, splitting radially with age; hymenium 40-45 µm high; spores 8/ascus, colorless, ellipsoidal, ca 4 X 7 µm.

Chemistry: Atranorin, protocetraric acid, physodalic acid, and physodic acid.

Type: On stunted conifers along Pygmy Forest Reserve nature trail, Van Damme State Park, elev. 50m, Mendocino Co., California, M. E. Hale no. 49365, 9 June 1977 (US, holotype; duplicates to be distributed in Lichenes Americani Exsiccati).

Specimens examined (all in US). California: Del Norte Co., Doty 3412; Humboldt Co., Becking 61041020, Hale 56798; Marin Co., Hermann 17540; Mendocino Co., Tucker 6089. Oregon:

Coos Co., *Hale* 48934; Curry Co., *Hale* 49074; Douglas Co., *Leuthner* 24432; Lane Co., *Hale* 48821; Tillamook Co., *Pike* 3144.

Hypogymnia occidentalis Pike, sp. nov. Fig. 1a

Thallus adnatus, lobis irregulariter inflatis, brevibus, margine concolori, medulla nigra; apothecia numerosa; sporae 5 X 7-9 µm.

Thallus rather closely adnate throughout, whitish mineral gray, 5-10 cm broad; lobes rather short and irregularly inflated, 2-4 mm wide, lacking a black rim, the medullary cavity blackening above and below; lower surface black, deeply rugose, sparsely perforate. Pycnidia abundant; microconidia rod shaped to weakly bifusiform, 5-6 µm long. Apothecia abundant, substipitate, 3-10 mm in diameter, the rim upturned, the disc dark brown; hymenium 40-45 µm high; spores 8/ascus, colorless, ellipsoidal, 5 X 7-9 µm.

Chemistry: Atranorin and physodic acid.

Type: Big Canon, Wallowa Co., Oregon, *E.P. Sheldon* 8763, 23 Aug. 1897 (US, holotype).

Selected specimens examined (all in US). Alaska: Flat Island, *Thomas* 145. Oregon: Crook Co., *Hale* 49690; Curry Co., *Hale* 48921; Grant Co., *Hale* 49688; Union Co., *Sheldon* 9024. Washington: Spokane Co., *Bonser* s.n. Idaho: Bonner Co., *Hale* 49010; Boundary Co., *Hale* 48236. Montana: Flathead Co., *Hale* 48367; Lake Co., *Barkley* 2004; Lincoln Co., *Hale* 49562; Missoula Co., *Hale* 48834; Ravalli Co., *Hale* 48401; Sanders Co., *Hale* 48275. California: Humboldt Co., *Hale* 49730; Los Angeles Co., *Wheeler* 1554; Mendocino Co., *Hale* 49340; Plumas Co., *Hale* 51971; Siskiyou Co., *Hale* 51627; Sonoma Co., *Hale* 48295; Tehama Co., *Hale* 52286.

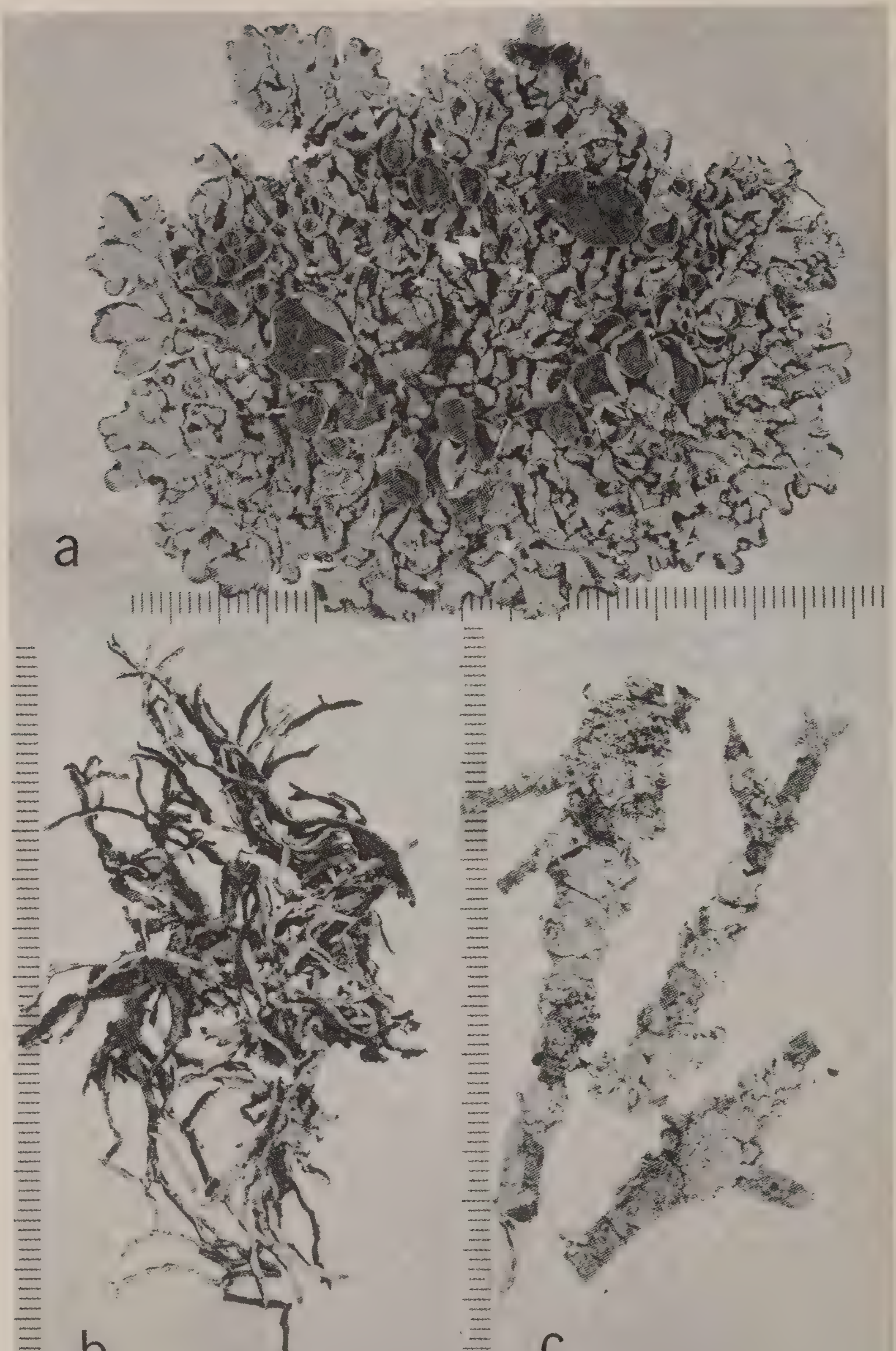
The name "enteromorpha" has been applied indiscriminately to virtually every nonsorediate *Hypogymnia* species in North America at some time. The eastern population was not split off until 1973 as *H. krogii* Ohlsson. Up to now the far more varied western populations have not been critically studied.

Much of the material labeled "H. enteromorpha" in the western states has in fact turned out to be *H. imshaugii* Krog, a widespread species, notoriously variable but easily recognized by the white medullary cavity (Krog, 1968). Almost all other species have a dark medulla. Further breakdown and understanding of this latter group has depended on accurate typification of the two oldest names, *H. duplicata* (Ach.) Rass. and *H. enteromorpha* (Ach.) Nyl., something we have now been able to do by examining appropriate lectotype materials in the British Museum (Smith herbarium) and isotypes at Helsinki (Acharian herbarium). *Hypogymnia duplicata,* a conspicuous but rather rarely collected coastal lichen from Alaska south to Oregon, is the species so clearly illustrated by Krog (1968, p. 95). The usual chemistry is atranorin, protocetraric acid, physodalic acid, and accessory diffractaic acid. We have not demonstrated physodic acid in any specimens, concurring with Ohlsson (1973).

We have based the typification of *H. enteromorpha* on the rich material in the Smith herbarium (BM) and comparison with the scraps in H. These specimens are strongly inflated, without a conspicuous black rim, more or less loosely adnate but sometimes somewhat trailing, and produce atranorin, protocetraric acid, physodalic acid, physodic acid, and accessory diffractaic acid (misidentified as barbatic acid by Krog using the microcrystal tests). In addition there is a second large population, also represented on the lectotype sheets, an acid-free chemotype containing only atranorin, which is morphologically indistinguishable from P+ plants. This species complex is very common from Alaska south to California, generally toward the coast in the Cascade ranges but also extending inland as far east as Idaho, where a few other typically Cascade lichens, such as *Platismatia stenophylla* and *Pseudocyphellaria anomala*, have been found.

The first of our new species, *H. heterophylla*, differs from *H. enteromorpha* in these respects: Lobes long and trailing, not grossly inflated, attached mostly at the center below, margins with a broad black zone, spores ellipsoidal (in *H. enteromorpha* nearly spherical, 5 X 6 µm), and diffractaic acid always lacking. Furthermore it has a much more restricted habitat and range, pine barrens, *Pinus contorta* in sand dune areas, *Quercus wislizenii* chaparral, etc., all within a few kilometers of the Pacific coast from central California to Oregon.

The second new species, *H. occidentalis,* is widespread in the Cascades (one collection from Alaska) and especially the northern Rocky Mountains in the United States, overlapping to a large extent—excepting Montana—the range of *H. enteromorpha*. It often grows on lower boles of Douglas fir and other conifers in dense forests and has a broad altitudinal range, from sea level to 1500 m. It has fairly distinctive morphological and chemical characters. The lobes are moderately inflated without a strong (or with no) black margin, as in *H. enteromorpha,* but more closely adnate with no tendency for the lobes to trail. The chemistry, atranorin and physodic acid, is another good diagnostic character, useful in separating the species not only from typical P+ *H. enteromorpha* but also from its P- (atranorin only) chemotype.



Figs. 1a-c. Holotype specimens of Hypogymnia: a, H. occidentalis; b, H. heterophylla; c, H. mollis (all in US). Scale in mm.

Hypogymnia mollis Pike and Hale, sp. nov. Fig. 1c

Thallus arcte adnatus, mollis et fragilis, lobis brevibus, congestis, superne diffuse sorediatis; apothecia ignota.

Thallus closely adnate on twigs, soft and fragile, white to grayish white, 3-6 cm broad; lobes short, about 1 cm long, and crowded, 1-3 mm wide, little branched, the upper surface at first continuous, shiny, but soon rugose, cracking and flaking and becoming diffusely sorediate over the whole surface; medullary cavity brown to blackening above and below; lower surface dull black, rugose, the tips perforate, part of the lower cortex often eroding away to expose the medulla. Apothecia and pycnidia not seen.

Chemistry: Atranorin and physodic acid.

Type: On shrubs in sandy area at Los Osos Oak Reserve, near Los Osos, San Luis Obispo Co., California, elev. 15 m, *M.E. Hale* no. 57768, 31 July 1980 (US, holotype; to be distributed in *Lichenes Americani Exsiccati*).

Specimens examined. California: San Diego Co., *Cota* 1447b (US), *Du Rietz* 206 (USP, US).

This rare but unusual *Hypogymnia* is easily recognized by the laminal diffuse soralia and the P- chemistry. It has no obvious relationship with any other species in North America. *Hypogymnia laminosorediata* Hawks. from Morocco has the same chemistry and extensive laminal soralia but the thallus is much larger and the medulla white on the roof of the cavity. Sorediate *H. tubulosa* (Schaer.) Hav., better known to lichenologists, also produces atranorin and physodic acid but has soralia delimited to the lobe tips. The three collections we have seen come from open coastal chaparral or scrub.

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A NEW SPECIES OF *PARMELIA* (LICHENES) WITH PROTOCETRARIC ACID

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Abstract.--A new species, *Parmelia protosulcata* Hale, is described from the Southern Hemisphere. It contains the depsidone protocetraric acid.

The genus *Parmelia* is typified by *P. saxatilis* (L.) Ach., a well-known boreal lichen characterized by effigurate pseudocyphellae (Hale, 1981). There are about 30 closely related species in this group, centered mostly in eastern Asia. While the majority contain salazinic acid, we have long known that *P. discordans* Nyl. is anomalous in containing protocetraric acid (along with lobaric acid), giving a negative KOH test in the medulla (Culberson, 1970). A lesser known species *P. pseudosulcata* Gyelnik, also produces this acid (Ohlsson, 1973). We can now add the species described below to this interesting complex, which now includes *P. crambidiocarpa* Zahlbr. from New Zealand, *P. kerguelensis* Crombie from the subantarctic islands, and *P. discordans* and *P. pseudosulcata*.

Parmelia protosulcata Hale, sp. nov. Fig. 1

Thallus adnatus, corticola, lobis sublinearibus, 2-3 mm latis, superne effigurato-pseudocyphellatis, planis, margine sorediatis, subtus nigris, rhizinis simplicibus vel sparse furcatis. Apothecia rara, sporis simplicibus, incoloribus, 7-9 X 11-13 µm.

Thallus adnate to loosely adnate on bark, pale greenish to brownish mineral gray, 2-6 cm broad; lobes sublinear, short, contiguous, 2-3 mm wide, the surface plane, rarely weakly foveolate, becoming faintly pruinose at the tips, deeply reticulately fissured in older parts; pseudocyphellae effigurate, small, rather sparsely developed, mostly toward lobe tips or on the margins, usually elongate; soralia developing on lobe tips or margins, usually orbicular but fusing and linear or densely ag-

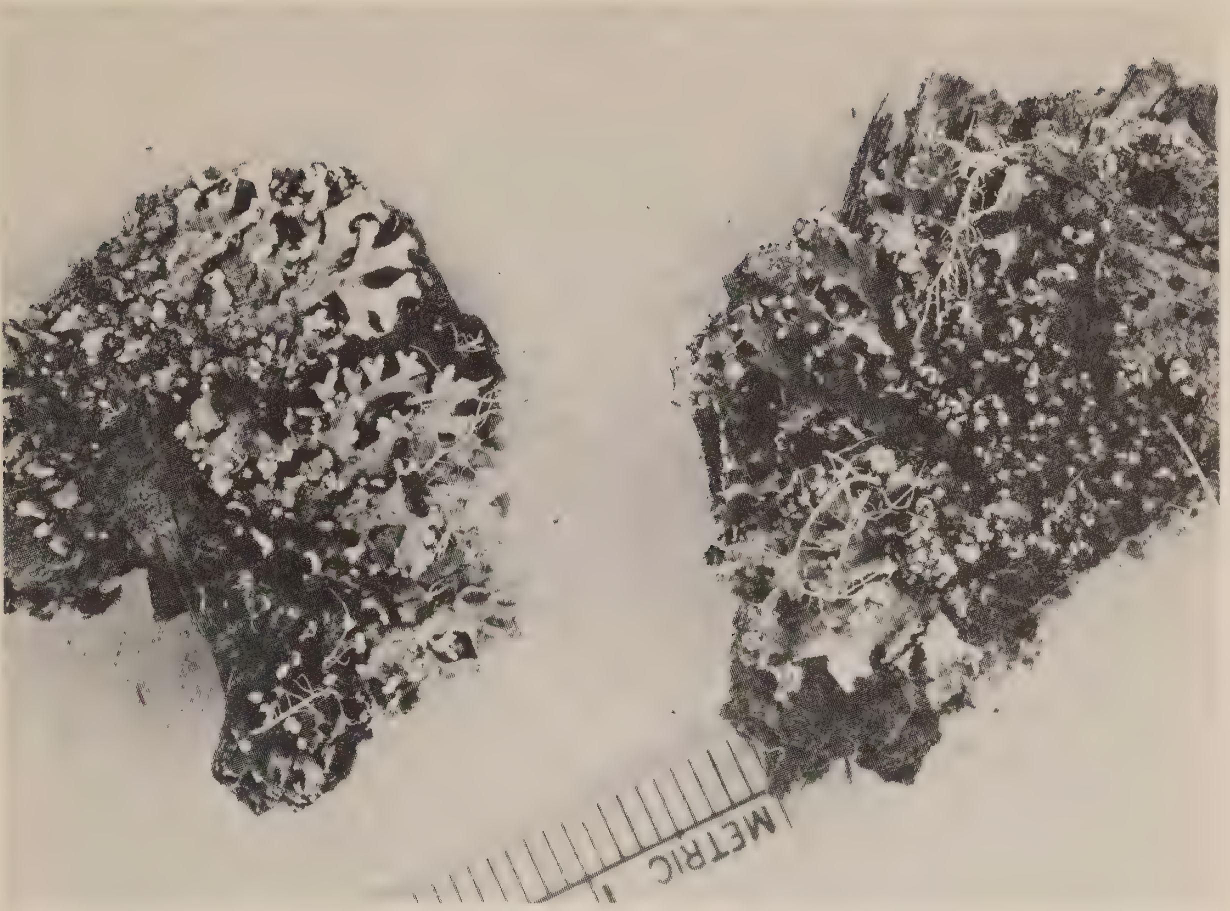

Fig. 1. Isotype of Parmelia protosulcata Hale in US.

gregated with age, the soredia coarse; cortex paraplectenchymatous, 14-16 µm thick, algal layer ca 15 µm thick, medulla white, 80-110 µm thick, lower cortex carbonized, 15-18 µm thick; lower surface black, shiny, moderately rhizinate, the rhizines simple to sparsely furcate or weakly squarrosely branched. Apothecia rare, substipitate, 4-5 mm in diameter, the amphithecium rugose, pseudocyphellate; hymenium 60-65 µm high; spores 8, simple, colorless, 7-9 X 11-13 µm (data from Imshaug 45613).

Chemistry: Atranorin and protocetraric acid.

Type: On Nothofagus antarctica in an open N. antarctica forest, Cabezera Lago at eastern end of Lago Fagnano, Tierra del Fuego, Argentina, R. Santesson 7955, 30 Mar 1940 (S, holotype; US, isotype).

This is a strictly austral species, very common with P. sulcata Tayl. in the Straits of Magellan region and southern Chile, especially in moist Nothofagus forests. It is also present on at least one of the subantarctic islands. The orbicular, mostly marginal soralia are quite distinct from the linear, laminal ones of P. sulcata, its closest relative, which is also distinguished by densely squarrosely branched rhizines.

Two specimens from Chile (Prov. Cautin, Rundel 7457 and Prov. Malleco, Mahu 2474, both in US) contain fumarprotocetraric acid only and seem to represent a chemotype, not entirely unexpected although this acid had not previously been reported in the genus.

Specimens examined. New Zealand: Campbell Island, Harris 5455 (MSC, US). Falkland Islands, Howkins 2964 (FH). Chile: Prov. Magallanes, Imshaug and Ohlsson 43842, 43896, 44401, 44805, 44568, 45155, 45570B (all MSC), 45613 (MSC, US), Santesson 1843 (S, US); Prov. Osorno, Imshaug 42961 (MSC); Brunswick Peninsula, Imshaug and Harris 39095, 39260, 39328, 39329, 39404 (MSC).

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A new host for *Sphaeronaemella helvellae* -- *Pseudorhizina sphaerospora*

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While examining material of Helvellaceae in North America, a specimen of *Pseudorhizina sphaerospora* (Peck) Pouzar (≡ *Helvella sphaerospora* Peck ≡ *Gyromitra sphaerospora* (Peck) Sacc.) was studied and found to be infected with *Sphaeronaemella helvellae* (Karsten) Karsten (Pyrenomycetes, Melanosporaceae). Previous reports of this fungus have been made by Seeler (1943), Wells and Kempton (1968), Malloch (1974), and recently by Cannon and Hawksworth (1982). All of these reports have been based on parasitized material of *Gyromitra infula* (Schaeffer) Quélet and *G. ambigua* (Karsten) Harmaja. This is the first notice of *S. helvellae* on *P. sphaerospora*. Though *S. helvellae* does not seem to be common, it seems to be widespread in North America. Wells and Kempton (1968) stated that in the Anchorage area *Gyromitra infula* is frequently infected with *S. helvellae*, indicating that local epidemics might be quite common.

The material of *S. helvellae* on *P. sphaerospora* differs only slightly from that on species of *Gyromitra*. Seeler (1943), Malloch (1974), and Cannon and Hawksworth (1982) described the perithecia as being superficial to semi-immersed. The perithecia on *P. sphaerospora* are often deeply embedded with only the necks projecting. In general, the perithecia are somewhat smaller than those described from *Gyromitra* spp. Perithecia from *P. sphaerospora* range from 90 to 110 µm.

Virtually nothing is known of the biology of this parasite. The presence of *S. helvellae* on *P. sphaerospora* might indicate a close alliance of *P. sphaerospora* with the species of *Gyromitra* but so little information is available that no conclusion can be drawn. Certainly all the Gyromitras and allies should be examined for this parasite to determine if the host range of *S. helvellae* is broader than presently understood.

Specimens examined: On *Pseudorhizina sphaerospora*. New York, Undercliff, trail to Lock Bonnie, June 27, 1899, R. A. and A. M. Harper (FH). On *Gyromitra infula*. Shelburne, N.H. W. G. Farlow (FH, cited by Seeler). On *Gyromitra infula*. In moss and on swampy ground at edge of boreal forest beaver pond, Tarzwell, Ontario, Canada, George P. White (965) (FH).

This work was supported by National Science Foundation Grant DEB 8023018.

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SMITTIUM LONGISPORUM, A NEW HARPELLALES (TRICHOMYCETES) FROM CHIRONOMID GUTS

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The fungal genus *Smittium* (Harpellales, Legeriomycetaceae) has 18 recognized species, including the zygospore-producing one described in this paper. *Smittium* species inhabit the hindguts of aquatic Diptera larvae such as midges (Chironomidae, Ceratopogonidae), mosquitoes (Culicidae), and blackflies (Simuliidae). Of the 18 species, 14 were described from midges (including the present species), three from mosquitoes, and one from blackflies. Some species are able to infest more than one host family. For example, we have found *S. culicis* and *S. culisetae*, normally in mosquito larvae, in the guts of blackfly larvae. Williams and Lichtwardt (1972) collected trichospores from axenic cultures of four *Smittium* spp. isolated from various geographic locations and from different dipteran hosts (chironomids, mosquito, and blackfly larvae), fed them to mosquito larvae (*Aedes aegypti*), and demonstrated that there was some degree of host preference by the fungi at the insect family level. Zygospores have been described from only six species, all of them from Chironomidae. The currently known distribution for the new species, *S. longisporum*, includes several midwestern states of the U.S.A. and one site in Sweden above the Arctic Circle.

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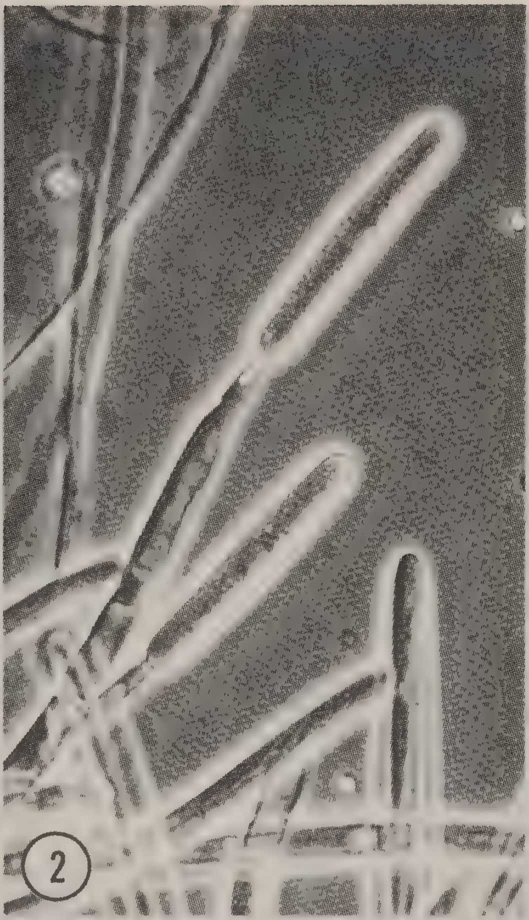

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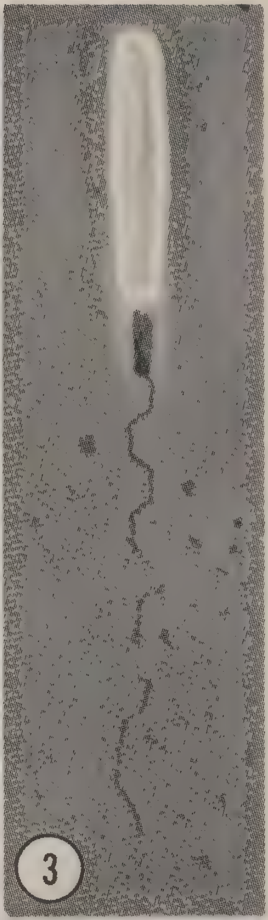

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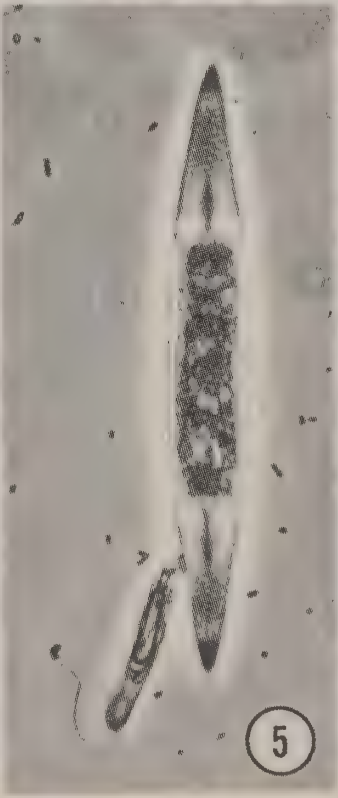

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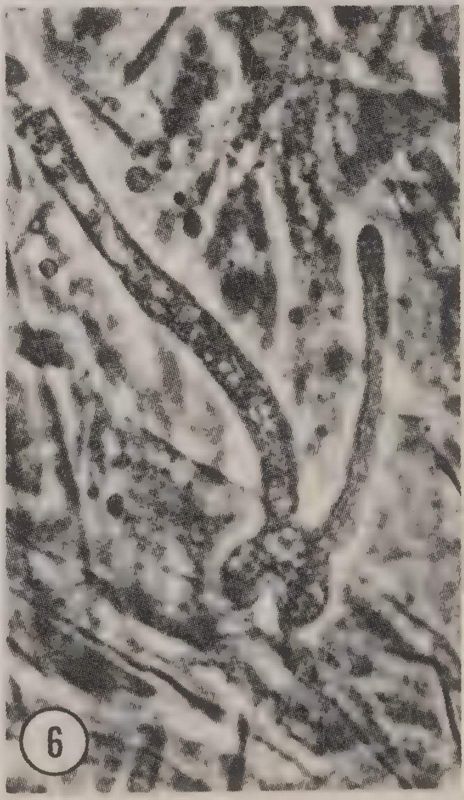

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Smittium longisporum Williams, Lichtwardt & Peterson, sp. nov.

Trichosporae elongate fusiformi-ellipsoidales, (40-)46 (-55) × (6-)8(-10) μm, collare (10-)13(-17) × ca. 4 μm. Cellulae genitales longae plerumque 1-2 trichosporae in ramo fertili omni producentes. Zygosporae oblique affixae, fusiformi-biconicae, (102-)110(-113) × (13-)15(-17) μm, collare 28-32 × ca. 5 μm lato, ad regionem (11-)14(-18) μm a termino uno zygosporae affixo, appendiculo unico praedito. Chironomidarum larvalium incola.

Trichospores long fusiform-ellipsoidal (40-)46(-55) × (6-)8(-10) μm with a long, well-defined appendage which often has a zigzag appearance upon release of the trichospore; collar (10-)13(-17) × ca. 4 μm, slightly bulged centrally. Usually 1-2 trichospores per fertile branch produced on long generative cells. Zygospores fusiform-biconical (102-)110(-113) × (13-)15(-17) μm, collar 28-32 × ca. 5 μm attached (11-)14(-18) μm from one end of the zygospore which bears a single appendage several times longer than the zygospore; attached obliquely to the zygosporophore which arises laterally from one of the conjugants. Basal cell with two downward-curved projecting branches. Growing in the hindgut of several species of larval Chironomidae.

Holotype: Slide DGK-1-1 deposited with R. W. Lichtwardt at the University of Kansas, prepared from the hindgut of a *Cricotopus* sp. larva collected 2 January 1981 in Rock Creek, Section 8, T14S, R18E, Douglas County, Kansas, USA, where County Road #462 intersects Rock Creek.

Figs. 1-6. *Smittium longisporum*. 1. Developing trichospores, ×575; note early collar development (subterminal spore) followed by spore enlargement (terminal spore). 2. Trichospores nearing maturity, ×575. 3 and 4. Mature released trichospores with the characteristic long collar and zigzag appendage, ×650. 5. Zygospore, ×535; most of the single appendage can be seen furled within the long collar. 6. Basal cell of a young thallus, ×780; note the branch growing from the clasplike holdfast portion of the cell.

Collections: In addition to the type locality, thalli and trichospores were found in larval Chironomidae from: a small stream draining into the north shore of Lake Torneträsk across from the Abisko Naturvetenskapliga Station, Sweden, 7 July 1971; Indian Creek 3.6 km S of highways MO 17 and US 63 junction, Texas County, Missouri, USA, 5 February 1982; Platte River just S of highways I 80 and NE 10 (Minden interchange), Buffalo County, Nebraska, USA, 15 April 1982; Neosho River 1.6 km E of highways US 50 and I 35 interchange near Emporia, Lyon County, Kansas, USA, 1 May 1982. All host collections were made in flowing waters.

The long, relatively wide trichospores readily differentiate this species of *Smittium* from all others presently described (Figs. 1-4). The only species which somewhat resembles this one is *S. macrosporum* Kobayasi (1969), whose trichospores are similar in shape but are shorter and narrower with a shorter collar, and whose walls are described as being coarse or finely verrucose; no zygospores have been reported in that species. The holdfast of *S. macrosporum* was described as a short-cylindrical peg arising from a branching basal cell, whereas in *S. longisporum* the basal cell has a clasping appearance due to the growth of two downwardly curved projections (Fig. 6), and the secreted holdfast structure present in many trichomycetes is not evident. The basal cell is about 7 µm in diam, with up to five lateral branches growing from the downward projections in more mature thalli. The branches of the main part of the thallus measure about 7 µm in diam near the base, about 9.5 µm at the widest part, with the generative cells on terminal branches measuring about 4 µm in diam.

Our trichospore measurements were made from phase-contrast photographs of living material mounted in water. We noticed that some shrinkage of trichospores (ca. 1 µm in width) occurred after the water mounts were fixed in lactophenol-cotton blue.

Conjugation in sexual reproduction is accomplished when two hyphae send out lateral protruberances which meet and fuse. One of the conjugants then elongates and swells to produce the zygosporophore, and a terminal zygospore begins to form at an obtuse angle to the zygosporophore. As development continues, the region of the zygosporophore below what will become the collar of the zygospore swells such that it is often twice the diameter (ca. 10 μm) of the supporting conjugant cell and the collar. A weak circumferential zone may be observed in the wall of the zygosporophore where the collar will eventually detach. The coiled appendage may be seen through the collar of the attached, maturing zygospore (Fig. 5). After zygospore release, it appears that the single appendage may not extend completely until stimulated by some mechanical action. In contrast, the appendage of trichospores often extends from the collar in its typical zigzag manner as soon as the trichospore is released.

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MYCOTAXON

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MEGASPOROPORIA A NEW GENUS OF RESUPINATE POLYPORES[1]

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SUMMARY

The genus Megasporoporia Ryv. & Wright is described with Poria setulosa Henn. as type species. The genus is characterized by large pores and spores, clamped generative hyphae and dextrinoid skeletal hyphae. The following new combinations are proposed: Megasporoporia cavernulosa (Berk.) Ryv., Megasporoporia hexagonoides (Speg.) Wright & Rajch. and Megasporoporia setulosa (Henn.) Rajch. Megasporoporia mexicana Ryv. is described as new.

Grammothele as defined by Ryvarden & Johansen (1980:34-35) included taxa with a resupinate, poroid fruitbody where the basidia lined both the walls and the bottom of the pores. Microscopically the species were characterized by dextrinoid skeletal hyphae and in many species also dendrohyphidia were present. The spores in all taxa were ellipsoid to cylindrical, non-amyloid and thinwalled with one exception. Jülich (1982) excluded G. macrospora Ryv. and transferred it to Grammothelopsis Jül. because of its thickwalled, dextrinoid spores.

Among the remaining species G. delicatula (Henn.) Ryv. and G. setulosa (Henn.) Ryv. are somewhat deviating as they both have much larger pores and spores than the type species of the genus, viz. G. lineata Berk. & Curt. Further studies in the resupinate polypores have shown that there are two more species which are closely related to G. delicatula and G. setulosa. We feel that these 4 species constitute a natural taxon and propose a new genus to accomodate them.

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1) Work partially subsidized by a grant from the Consejo Nacional de Investigaciones Científicas y Técnicas.
2) Member of the "carrera del investigador científico" of the above Consejo.
3) Fellow of the above Consejo.

MEGASPOROPORIA Ryvarden & Wright nov. gen.
Frutificatio resupinata, pori magni, pori facies cremea, cinerea ad pallidum cinnamomea, systema hypharum dimiticum ad trimiticum, hyphae generatoriae fibulatae, hyphae skeletales crasse tunicatae, dextrinoideae, hyphae liganteae dextrinoideae, praesentes vel absentes, dendrohyphidia praesentia vel absentia, sporae magnae, hyalinae, cylindricae, non-amyloideae, tenuitunicatae.
Species typica: Poria setulosa Henn. Engl. Bot. Jahrb. 28:321, 1901.

Fruitbody resupinate, pores generally large, angular to round, pore-surface cream, greyish to pale brown or cinnamon, context usually very thin white to cream or very pale brown. Hyphal system di-trimitic, generative hyphae with clamps, skeletal hyphae thickwalled and dextrinoid, branched vegetative hyphae which may be interpreted as binding hyphae present in most species, dextrinoid. Spores cylindrical, thinwalled and large, non-amyloid and non-dextrinoid. Cystidia absent, dendrohyphidia present or absent, crystals usually present, often abundantly in the subhymenium and the context. On deciduous wood with a white rot. Predominantly a tropical genus.

Remarks. The genus is characterized by its resupinate fruitbodies, the large spores and pores besides strongly dextrinoid skeletal hyphae. From Grammothele as defined by its type species, it is separated by the larger spores and pores and a more distincly poroid fruitbody. In Grammothele the pores are in general small to minute and very shallow, which give the hymenophore a reticulate pattern or the aspect of low ridges more than a distinctly poroid appearance. The presence of dendrohyphidia in some of the species described here seems to point to a relationship to Grammothele as such organs in general are rare among the polypores. Dendrohyphidia are often very difficult to observe in dried polypores and they may have a wider distribution than hitherto assumed. Fresh or properly dried specimens are necessary to acertain their presence. Even if dendrohyphidia should be absent in some species we nevertheless feel that the characters mentioned above justify the genus in its present circumscription.

The hyphal system is somewhat difficult to interpret. The vegetative hyphae in some of the species show transitions from unbranched long and thickwalled skeletal hyphae to more sinuous hyphae with occasional branching up to arboriform or irregularly branched hyphae. The latter, when observed in freefloating segments, may easily be taken as true binding hyphae. They should better be called branched skeletal hyphae since they often have in the lower part long unbranched segments.

Key to species:

1. Pores 2-3 mm wide .... 3. M. mexicana

1. Pores less than 3 mm wide 2

2. Hyaline, acute hyphal pegs abundant in the pores ....4. M. setulosa

2. Hyaline hyphal pegs absent or only very few present 3

3. Pore surface grey to greyish brown, pores 0,5-1 mm wide, spores 16,5-22 um long, dendrohyphidia absent .... 2. M. hexagonoides

3. Pore surface pale cream to ochraceous, pores 2-4 per mm, spores 10-16 (18) um long, dendrohyphidia present along the pore edges .... 1. M. cavernulosa

1. MEGASPOROPORIA CAVERNULOSA, (Berk.) Ryv. Fig. 1. Comb.nov. - Basionym: Polyporus cavernulosus Berk. Hook. J. Bot. 8:235, 1856. - Poria delicatula Henn. Engl. Bot. Jahrb. 34:44, 1904. - Hexagonia heteropora Pat. J. Bot. (Morot) 3:166, 1889. - Hexagonia bartlettii Mass. Bull. Misc. Inform. Kew. 1908:216, 1908. - Poria linearis Murr. Mycologia 12:303, 1920.

Fruitbody annual, resupinate, effused, adnate and coriaceous, up to 2 mm thick. Pore surface first white to cream, then pale strawcoloured and finally when dry and old, ochraceous to pale woody brown. Pores angular and shallow, 2-4 per mm, up to 1 mm deep, pore edges finely fimbriate in actively growing specimens. Context white to pale strawcoloured.

Hyphal system trimitic, generative hyphae thinwalled, 2-3 um wide and with clamps, often difficult to find, skeletal hyphae dominating, thickwalled, mostly sinuous and unbranched, 2-3 um wide and strongly dextrinoid, binding hyphae or branched skeletal hyphae also present, especially in the context, arboriform and 2-4 um wide, strongly dextrinoid. Dendrohyphidia present, but difficult to observe in old and dry specimens, most easily seen along the pore-edges where they are abundant in young and growing specimens, hyphodid to ventricose with irregular branching in the upper part, arising from a clamp at the base, up to 25 um long. Spores cylindrical, hyaline, thinwalled and non-amyloid, variable in size, 10-16 (18) x 5-7 um, when young and immature apparently somewhat ellipsoid; when mature longer and slender. Habitat: On deciduous wood. Distribution: Tropical Africa and America.

Remarks. The size of the spores deserves some remarks. The type of P. cavernulosus Berk. is not sterile as stated

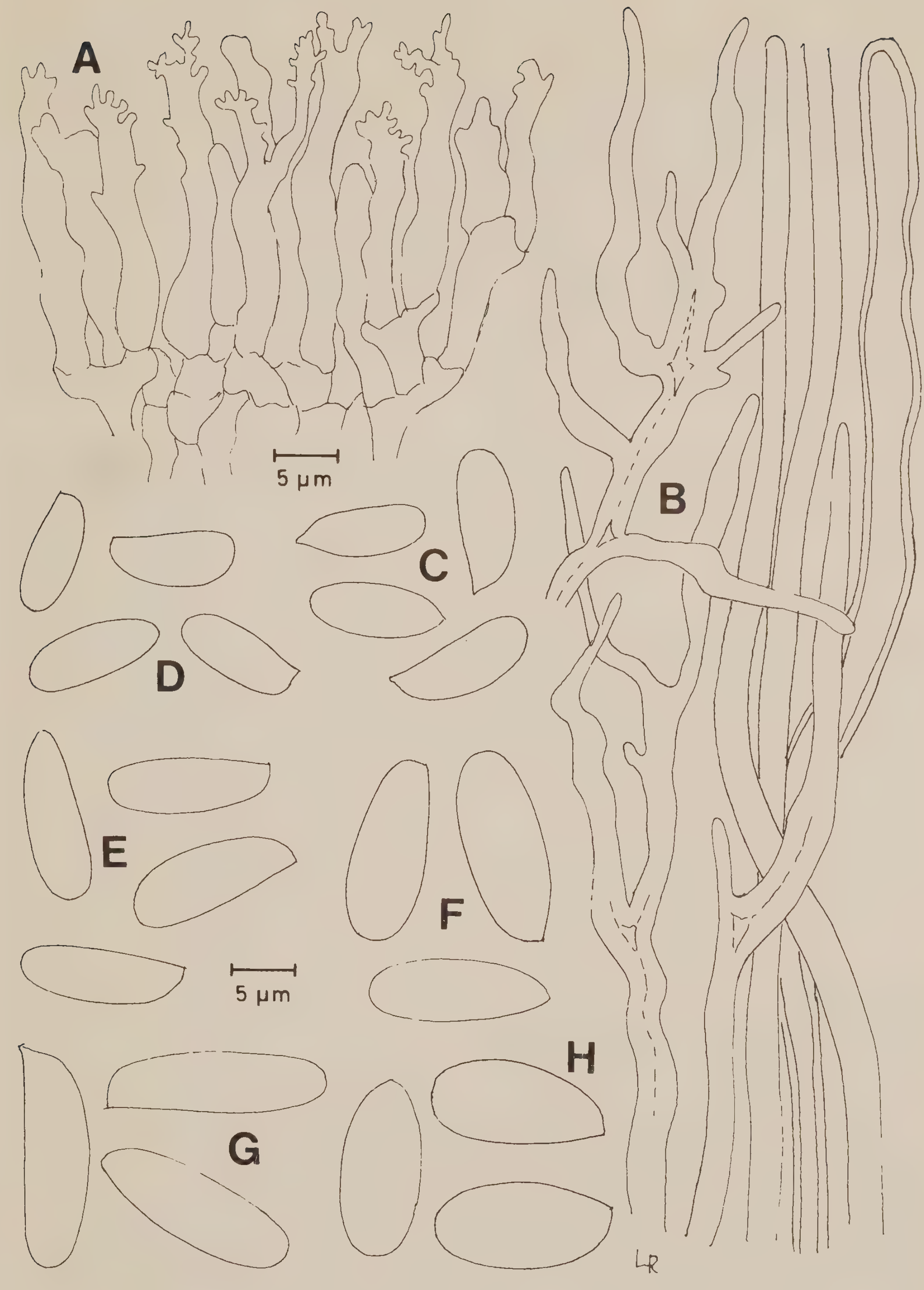

Fig.1. Megasporoporia cavernulosa A) section through the hymenium. Coll. R. 10760, B) vegetative hyphae, C) spores. From the type of P. cavernulosus, D-H) Spores, D) From the type of Poria linearis, E) Andersson, 2o,3,1980 (Ecuador), F) Deighton 1.8.1949, (Sierra Leone), G) Ryvarden 10760 (Kenya), H) From the type of Poria delicatula Henn.

by Lowe (1966:130). After repeated examinations spores were found that measured 9-12 x 4-5 um. The dextrinoid reaction of the skeletal hyphae is very strong in this specimen. In the type of Poria delicatula the spores measured 12-16 x 4-6 um while all intermediate sizes were found in others specimens examined. We believe that the medium sized pores, the cream to ochraceous fruitbody and the strongly dextrinoid skeletal hyphae are diagnostic for this species. The relatively large spore-variation that can be observed from the type of P. cavernulosus and of fresh specimens collected in Ecuador (see list below) probably reflects only different stages in development. After having examined many specimens from Africa and America we came to the conclusion that a separation based on spore size was not possible.

The description given by Ryvarden & Johansen (1980:37) was based partly on an undescribed species with almost the same size of the spores but with yellow and non-dextrinoid skeletal hyphae. This species will be treated in a later paper.

Representative specimens: Brazil, Panuré, Ad ramos (type of P. cavernulosus, K!); Bahia, Serra da Agua de Rega, 28/II/1971. H.S. Irwin. (NY). Cuba. Coll. Wright 451 (det. P. cavernulosus by Berkeley). Panama: Marragante, leg. H. Williams 3/IV/1908 (type of Poria linearis Murr.). (NY). Ecuador: Pastaza: Curaray, 20/III/1980. (GB). Guyana: Tumatumari, Leg. G. Linder, 16/IX/1923. (NY). Tanzania: Usambara, Bomole, May 1902, leg. G. Zimmermann (type of Poria delicatula Henn., S). Morogoro prov. Uluguri Mts. Morning Side Res. Sta. 24/II/1973, L. Ryvarden 10944 (O). Zaire: Shaba prov. Luisursiti, no date, leg. Thoen no 5431 (BR,O).

2. MEGASPOROPORIA HEXAGONOIDES (Speg.) Wright et Rajchenberg comb. nov. Fig. 2.
Basionym: Poria hexagonoides Speg., An. Mus. Nac. Buenos Aires 6:170-171. 1898.
Fruitbody annual, lignicolous, totally effused and attached to substratum, circular to largely ellipsoid up to 10 x 4 cm, hard, coriaceous. Pore surface when fresh light ash grey with lavender tints, when dry light greyish brown. Margin absent or present and then defined and regular, always cream, up to 2 mm wide. Pores large, honey-combed, 0,5-1 mm wide. Context thin, light brown, 0,3-1,7 mm thick. Tubes up to 2,5 mm long, concolorous with context, with triangular section. Alkali reaction negative.

Hyphal system trimitic. Generative hyphae clamped, branched, thin-walled, 2,1-3,6 um diam.; skeletal hyphae branched or not, with hyaline thickened walls or solid, 2,1-6,8 um diam., dextrinoid; binding hyphae branched with long and/or short branches, with hyaline thickened walls, 1,0-3,6 um diam., dextrinoid, all the hyphal elements are arranged intricately in the trama.

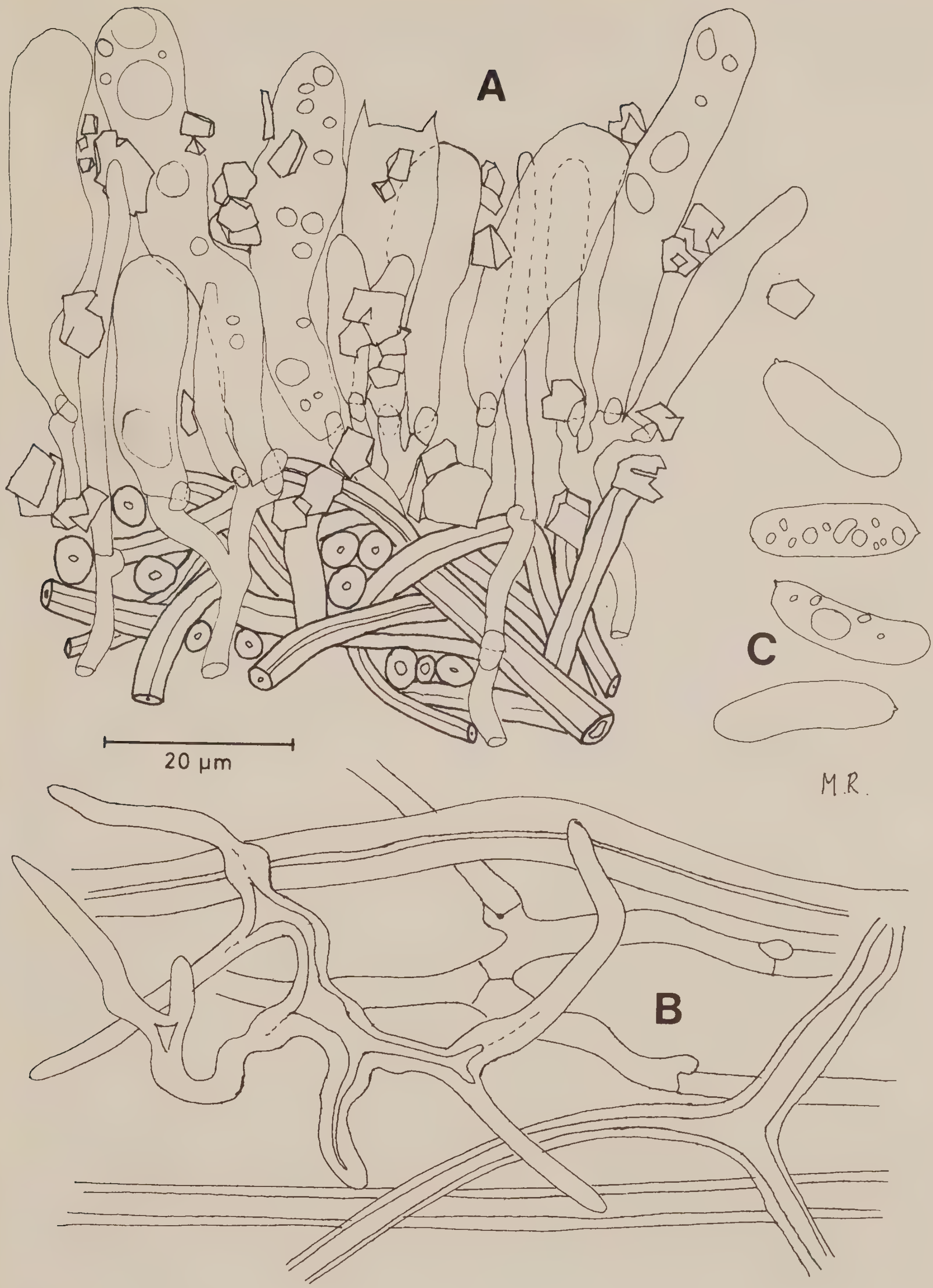

Fig. 2. Megasporoporia hexagonoides A) section through the hymenium, B) hyphae, C) spores. From the lectotype.

Hymenium 35-53 um thick. Basidia claviform 33,8-36,4 x 9,4-10,4 um, tetraspored, sterigmata triangular up to 6,2 um long. Basidiospores cylindric to slightly allantoid, apiculated, hyaline, thin-walled, with or without oily inclusions, 16,6-21,8 x 5,2-6,8 um, inamyloid, indextrinoide, acyanophilous. Basidioles cylindric to claviform 20,8-46,9 x 5,2-11,4 um, with or without distinct oily drops. Crystals polyedric, abundant, scattered between hymenial elements and in subhymenium. Cystidia absent.

Habitat: Prosopsis nigra and other unidentified angiosperms with a white rot. - Distribution: Argentina: In subxerophytic vegetation of the Chaco region (provinces of Salta, Santa Fé and Tucuman).

Remarks. The species has only slightly smaller spores and pores than M. mexicana, but is easily identified in the field because of its ashy grey to lavender fruitbodies. Lowe (1966:134) states that the isotype in BPI is sterile, but in the holotype in herb. LPS all hymenial elements are present.

Representative specimens: Argentina, Salta, La Vina, leg. Spegazzini, I/1897 (HOLOTYPE LPS 25538), between Rosario de la Frontera to G. Garmendia, leg. A. Okada VIII/1963 (BAFC 27916). Ibid., Güemes, Mojotoro River, leg. J. Deschamps SA-2910 5/III/1976, on living branches of Prosopis nigra (BAFC 27927). Santa Fé, Santa Margarita, leg. G. Domínguez 2/X/1943 (BAFC 27918). Tucumán, Dique del Cadillal, leg. R. Singer T-1568, 10/VI/1951 (BAFC 27919).

3. MEGASPOROPORIA MEXICANA Ryv. nov. sp. Fig. 3.
Fructificatio resupinata, pori facies cremea, pori magni, 2-3 mm latus, Systema hypharum di ad trimiticum, hyphae generatoriae fibulatae, hyphae skeletales haud ramosae vel ramosae et arboriformae, crasse tunicatae, dextrinoideae, sporae hyalinae, cylindricae, non-amyloideae 20-26 x 6-9 um. Typus: Mexico, Vera Cruz, Coscontla, Municipio de Huatuzco. 16/V/1973, 1300 m alt. Coll. F. Ventura 8320. Holotype in herb. ENCB, isotypi in herbaria O, K and BPI.

Fruitbody annual, resupinate, widely effused, in the type up to 20 cm long, 10 cm wide and 1 cm thick, tough and coriaceous. Pore surface white to pale cream, pores angular to round, 2-3 mm in diameter, tubes up to 1 cm deep, cream coloured, with a few scattered low hyphal pegs or warts in the upperpart. Context 2-400 um thick, white and fibrous, trama white and dense.

Hyphal system di-(tri?)-mitic, generative hyphae thin-walled, hyaline 2-4 um in wide and with clamps at the septa, skeletal hyphae strongly dextrinoid, thickwalled and of a variable shape, partly as long unbranched segments arising from a clamp, up to 500 um long and with a rounded apex, 3-7 um wide, partly as more sinuous segments of

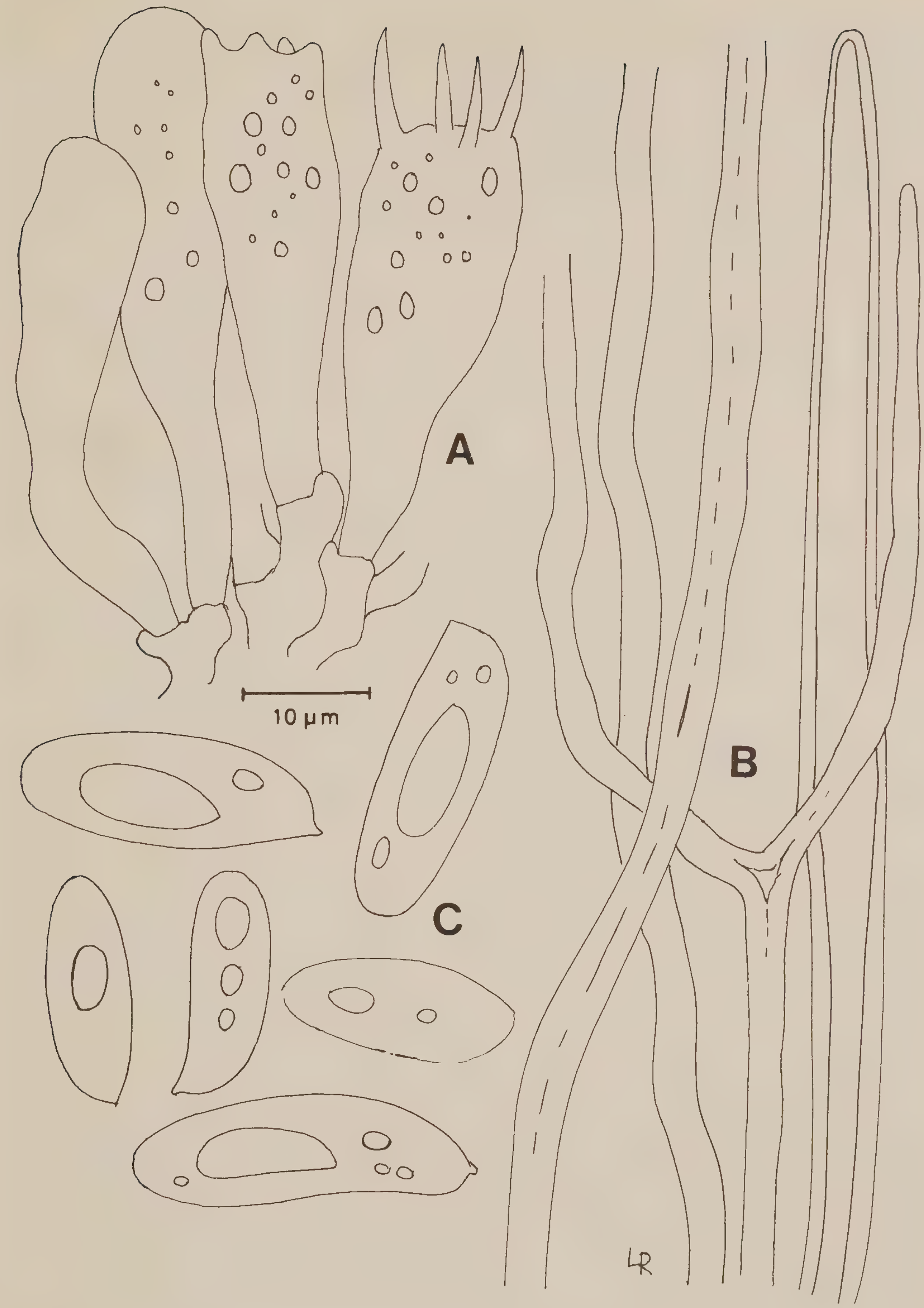

Fig. 3. Megasporoporia mexicana A) basidia, B) vegetative hyphae, C) spores. From the holotype.

variable length and with transitions to more narrow and dichotomously branched hyphae, 2-4 um wide. The latter type of hyphae is interpreted more as upper ends of skeletal hyphae more than true binding hyphae as the branching is rather scarce. Basidia clavate, 35-45 x 10-13 um with 4 sterigmata, hyaline paraphysoid hyphae present between the basidia, 3-5 um wide. Spores cylindrical to allantoid, thin-walled non-amyloid, hyaline and with smaller and larger oildrops, 20-26 x 6-9 um. On deciduous wood. Known only from the type.

Remarks. M. mexicana seems to be close both to M. setulosa and M. hexagonoides. From the former it is separated by far less hyphal pegs, larger spores and pores. From the latter it is separated by larger pores and a white to pale cream colour of the fruitbody.

4. MEGASPOROPORIA SETULOSA (Henn.) Rajchenberg Fig. 4. Nov. comb. - Basionym: Poria setulosa Henn., Engl. Bot. Jahrb. 28:321, 1901. - Trametes subsperpens Murr. Mycologia 12:108, 1920. Invalid name. no description.
Fruitbody annual, lignicolous, totally effused, forming small circular patches finally coalescing up to 30 x 6 cm, corky. Pore surface white, cream, turning light brown upon drying. Margin usually present, definite, regular, up to 1,7 mm wide, concolorous with hymenial surface. Pores round, isodiametric, 1-2 per mm. Context thin, up to 0,3 mm wide. Tubes up to 1 mm long. Alkali reaction negative. Hyphal system dimitic, generative hyphae clamped, branched, with thin hyaline walls, 1,6-3,1 um diam., and skeletal hyphae slightly or not at all branched, 1,6-5,2 um diam., with hyaline thickened walls with lumina visible, or solid, dextrinoid. All elements are intricately arranged and dissection is difficult. Hymenium 18,8-33,5 um thick. Basidia: claviform, with or without oily inclusions, 18,2-28,6 x 6,8-9,4 um, tetraspored, with straight or curved triangular sterigmata 7,8 x 2,6 um. Basidiospores cylindric, apiculated, hyaline, with large oil drops, thin walled, 10-14,0 x 4,2-5,7 um, inamyloid, acyanophilous. Basidioles claviform, with small or large oily inclusions, 13,5-31,2 x 5,2-10,4 um. Paraphysoids composed by generative hyphae that emerge between basidioles. Crystals polyedric, abundant, scattered in subhymenium and in trama, 11-54 x 16-43 um. Hyphal pegs very abundant, long and rectangular 40-160 x 16-38 um easily seen under the lens.

Habitat. On angiosperms with a white rot. Distribution. Pantropical.

Remarks. The species is usually recognized already in the field because of the numerous and prominent hyphal pegs inside the pores. The type of Poria setulosa was probably lost in Berlin during the last world war, but from the description and the name there should be no doubt that Hennings name originally covered the taxon described here.

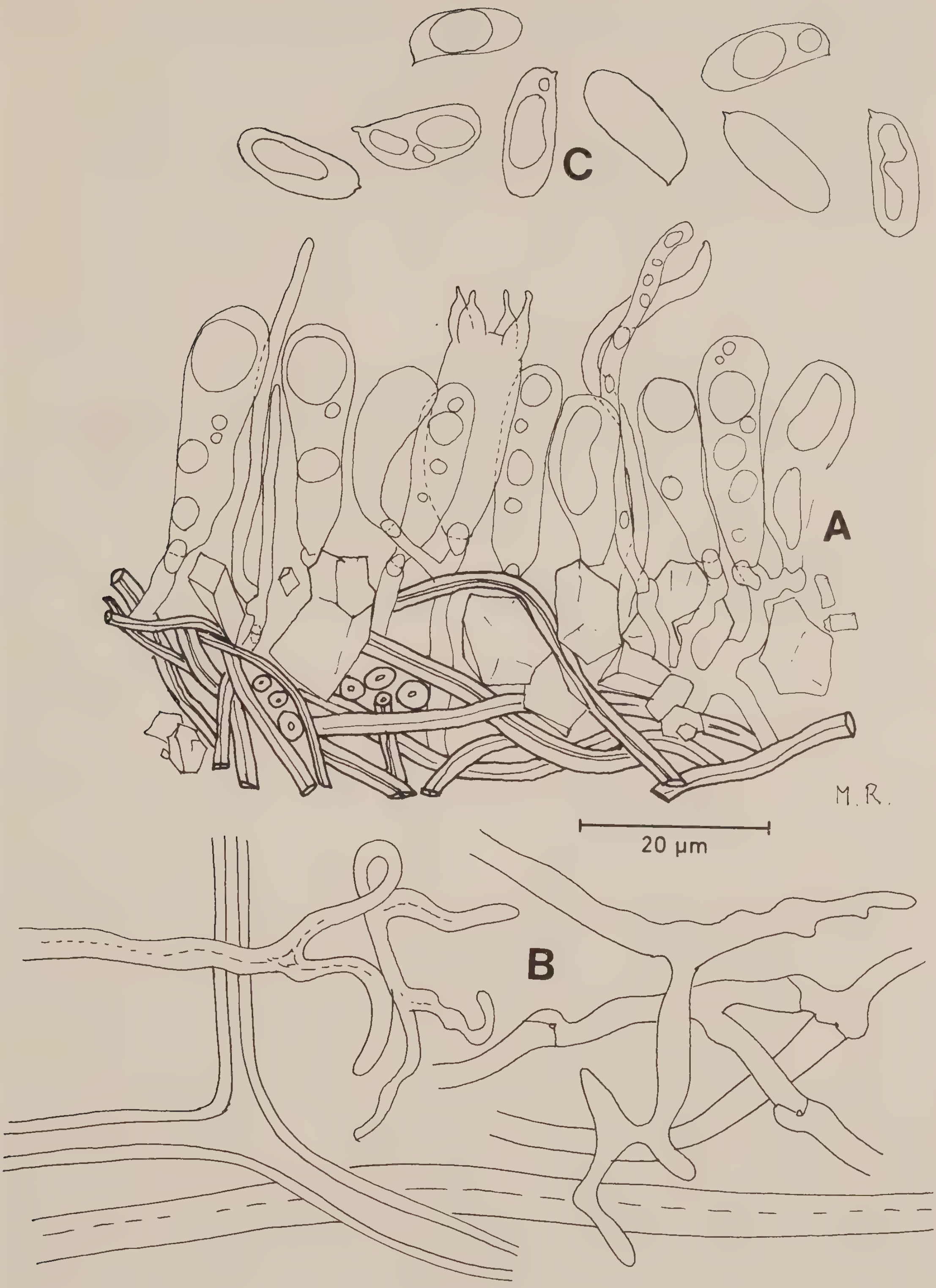

Fig. 4. Megasporoporia setulosa A) section through the hymenium, B) hyphae, C) spores. Coll. Rajchenberg 4.3. 1980 (Argentina).

Representative specimens: Argentina: Missiones, Cataratas del Iguazu, leg. M. Rajchenberg. 4/III/1980 (BAFC). Corrientes: Mburucuya. Ea. Santa Teresa, leg. J. Wright, Gomez & Del Busto. 28/I/1962 (BAFC). Venezuela: Bolivar Halo de Vergarena. L. Gupps. /X/1954 (NY). Ghana: Ashanti Region. Jimra Forest Reserve. 24/IV/1974. Ryvarden 12719 (O). Kenya: Coast prov. Shimba Hills, Makadara Forest. 14/II/1973. Ryvarden 10234 (ol). India: Tamil Nadu, Madurai distr. Tiger Shola. 17/VIII/1978. K. Kolanddavelu no I 34 (O).

Acknowledgements

We wish to express our recognition to the Servicio Nacional de Parques Nacionales, Argentina, for the facilities afforded during our field trips in the Iguazu National Park, and to the Consejo Nacional de Investigaciones Cientificas y Técnicas for financial assistance and the Fellowship granted to Mario Rajchenberg.

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SMITTIUM CELLASPORA, A NEW HARPELLALES (TRICHOMYCETES) FROM A CHIRONOMID HINDGUT

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This is the 19th recognized species of *Smittium* to be described, and the 15th described from midge larvae (Chironomidae, Ceratopogonidae). Previously described species of *Smittium* from all dipteran hosts have been collected from some 12 states of the U.S.A., including Alaska and Hawaii, and from Greenland, Russia, Japan, and at least five European countries.

Smittium cellaspora Williams, sp. nov.

Trichosporae ellipsoidales, (20-)29(-36) × (7-)8.5(-10) µm, appendiculo tenui pluries longitudinem sporae longo, collare (5-)9(-10) × ca. 2.5 µm. Thallus brevis, sparse ramosus, paene omnibus cellulis fertilibus. Retinaculum simplex, area adhesionis discformi. Zygosporae ignotae. Chironomidarum larvalium incola.

Trichospores ellipsoidal (20-)29(-36) × (7-)8.5(-10) µm with a fine appendage several times the spore length and which may exhibit a coiled appearance upon release of the trichospore; collar (5-)9(-10) × ca. 2.5 µm. Thallus short, up to 300 µm in length or possibly more, 6-10 µm in diam, sparsely branched, almost all cells fertile. Holdfast simple, tending to form a disklike adhesive structure. Zygospores unknown.

Holotype: Slide MIS-15-I deposited with R. W. Lichtwardt at the University of Kansas, prepared from the hindgut of a Chironomidae larva collected 7 February 1982 in the Sac River, 1.0 km north of the Greene County line on highway

MO 13, Polk County, Missouri, USA.

Hosts: Few hosts were collected from the type site and the one saved for identification is *Sympotthastia* sp. All chironomid hosts from this site were taken from leaf packs or algal growth attached to rocks in flowing water.

The spore size and unusual growth habit (Figs. 1-4) distinguish *S. cellaspora* from any currently described species. The only other species reported to have spores in this size range is *S. orthocladii* Manier (1969) {=*Rubetella orthocladii* Manier & Mathiez (1965) nom. nud.}. However, *S. orthocladii* is reported to have thalli with several basal branches growing in "bundles" which is distinctly different from the present sparsely branched species. *Smittium orthocladii* is described with trichospores measuring 25-33.5 × 6-7.5 µm with a collar (5-)8.7 (-10) µm and is reported to produce an encrustment surrounding the several basal branches. *Smittium cellaspora* has a wider spore and produces a disklike holdfast pad (Fig. 3) and no encrustment.

Smittium culicis has a similar spore shape; however, the trichospore is smaller and this species normally is found in mosquito larvae, while *S. cellaspora* is found in chironomid larvae.

The simple holdfast of the new species tends to form a disklike structure with an adhesive appearance as the thallus matures (Fig. 3). The basal cell is 30 to 50 µm long and the other cells range from 20 to 45 µm in length and from 6 to 10 µm in diam. The sparse branching pattern is a characteristic of this species and each cell generally is fertile or produces a branch which is fertile. Sporulation occurs early in the growth pattern as shown by a 2-celled thallus each with a spore (Fig. 2). Such an

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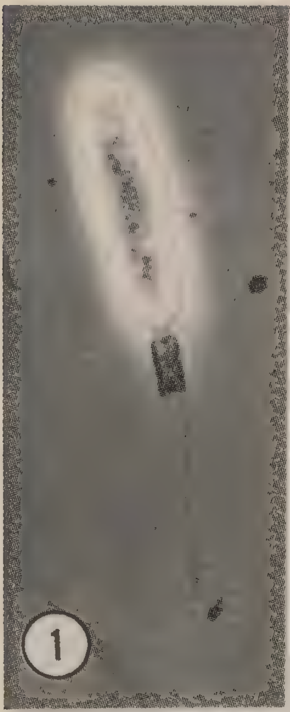
Figs. 1-4. *Smittium cellaspora*. 1. Trichospore with spiraled appendage and characteristic collar, ×1000. 2. Thalli attached to chitinous hindgut lining, ×225; note 2-celled thallus with 2 spores (arrow). 3. Branched thallus showing the disklike adhesive holdfast, ×675. 4. Thalli illustrating usual growth pattern, note lower thallus with each cell producing a spore, ×225.



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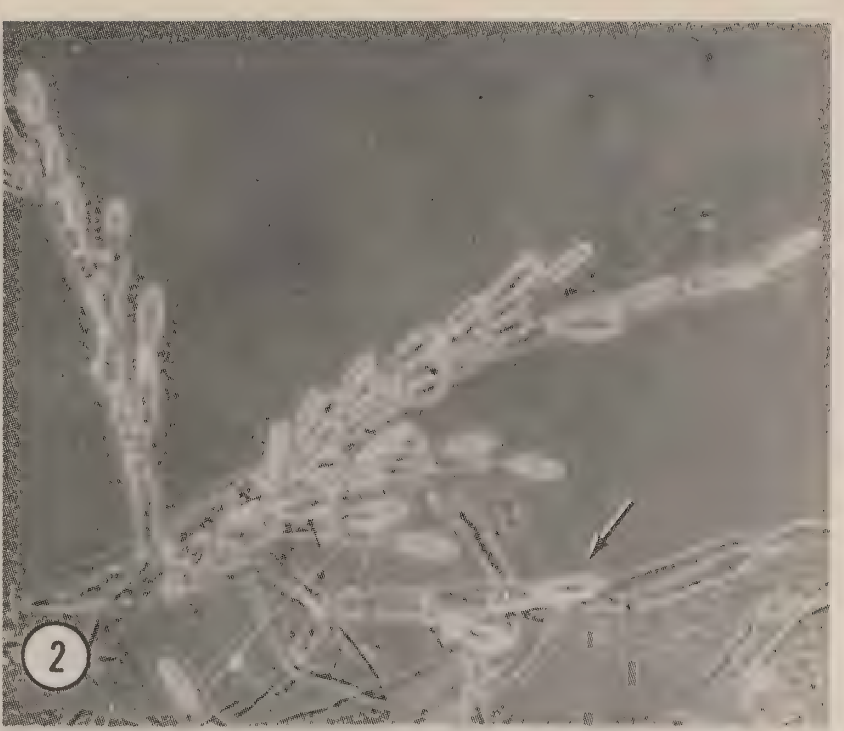

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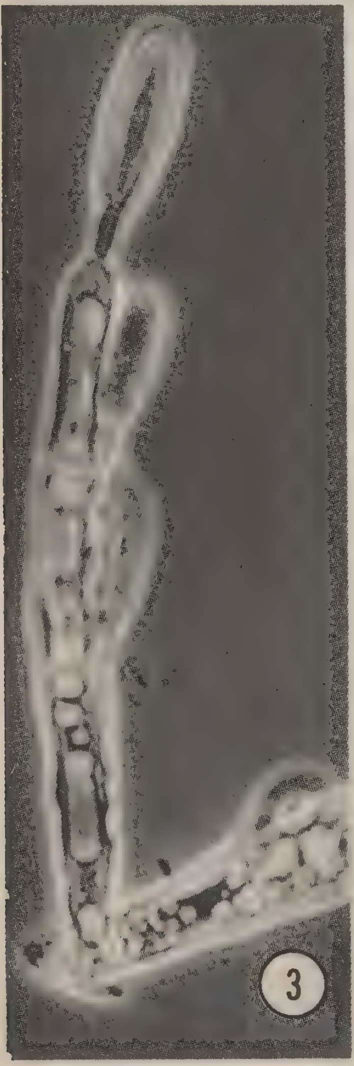

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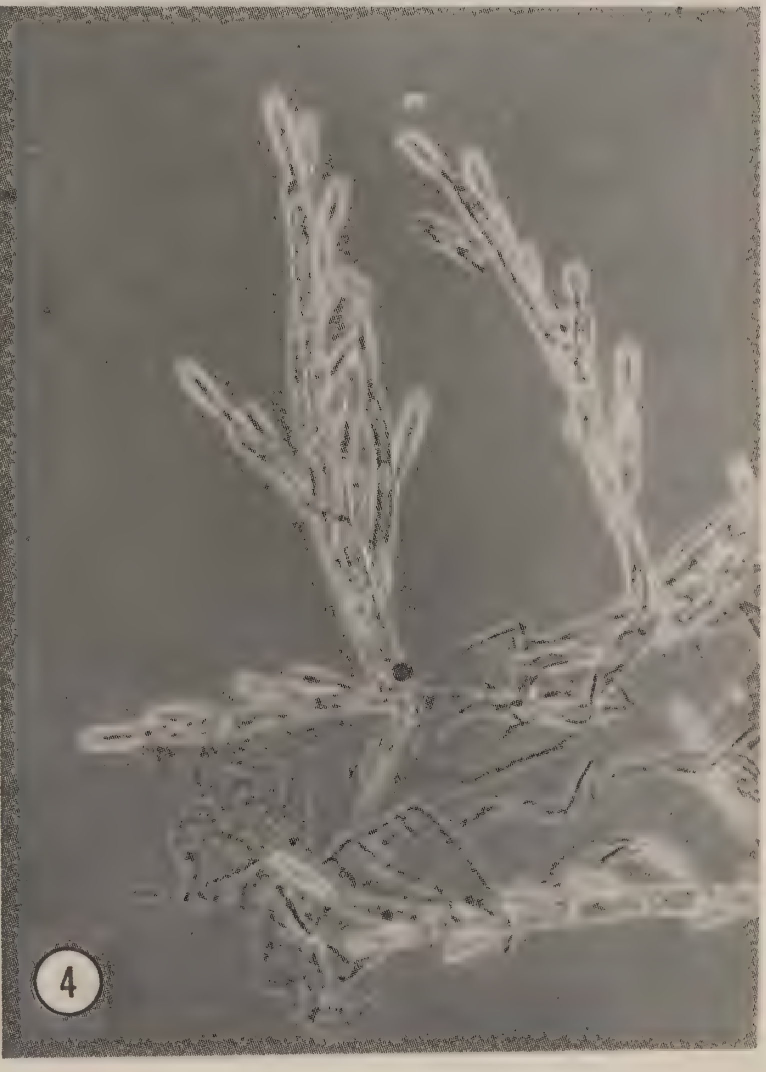

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abbreviated development is not generally reported in *Smittium* spp., and early sporulation has been observed only in laboratory infestations or axenic cultures. When spores of another species, *S. culisetae*, were fed to *Aedes aegypti* larvae in the laboratory, thalli were observed rarely to sporulate at the 2-celled stage in the hindgut. This precocious sporulation appears to occur when the fungus is becoming established shortly before the host larva is going to molt and is not the usual growth pattern. Also, in axenic cultures of *S. simulii*, single-celled germlings have been observed infrequently to produce a spore with no further vegetative growth.

It is not uncommon to find more than one species of *Smittium* growing in the same dipteran hindgut, therefore it is possible that *S. cellaspora* could be present in guts containing another *Smittium* sp. which produces more profuse growth. Under these conditions *S. cellaspora* may be overlooked due to its limited growth form.

The photographs and measurements were made from living material mounted in water. We noticed some shrinkage in trichospore width (ca. up to 1 μm) after the water mounts were fixed in lactophenol-cotton blue.

Acknowledgements: I am indebted to the Kearney State College Research Services Council, to the National Science Foundation for grant DEB-8019724 (Supplement), and to R. W. Lichtwardt for consultation and use of laboratory space at the University of Kansas. I wish to thank Dr. Leonard Ferrington for host identifications. Dr. Donald P. Rogers, Univ. of Illinois, kindly provided the Latin for the diagnosis.

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NOTES ON HYPHOMYCETES. XLII. NEW SPECIES OF *ACRODICTYS* AND *PSEUDOSPIROPES* FROM SOUTH AFRICA.

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ABSTRACT

Acrodictys eickerii Morgan-Jones and *Pseudospiropes falcatus* Morgan-Jones, two new species, are described and illustrated from collections made on decorticated twigs and wood in South Africa.

INTRODUCTION

In earlier papers in this series Morgan-Jones and Sinclair (1980a, 1980b) described new dematiaceous hyphomycete taxa, belonging to the genera *Stachybotrys* Corda and *Custingophora* Stolk, Hennebert and Klopotek respectively, from collections made on decorticated wood in South Africa. Continued exploration of this substrate has yielded collections of further undescribed species of which two, belonging to the genera *Acrodictys* M. B. Ellis and *Pseudospiropes* M. B. Ellis, are described herein.

TAXONOMIC PART

Acrodictys eickerii sp. nov. (Fig. 1).

Coloniae effusae, atrobrunneae vel atrae. Mycelium partim superficiale, partim immersum, ex hyphis ramosis, septatis, pallide brunneis, levibus, 2 - 3µm crassis compositum. Conidiophora macronemata, singula vel 2-3 fasciculata, non ramosa, ex lateribus hypharum oriunda, recta vel flexuosa, erecta, brunnea vel atrobrunnea, laevia, continua vel septata, usque ad 40µm longa, 5 - 6µm crassa, cum 0 - 2 proliferationibus terminalibus successivis. Cellulae conidiogenae monoblasticae, in conidiophoris incorporatae, terminales, determinatae vel percurrentes. Conidia solitaria, in apice conidiophori oriunda, sicca, subglobosa vel late pyriformia vel turbinata, muriformia, levia, brunnea vel atrobrunnae, 38 - 64µm longa, 22 - 42µm crassa,

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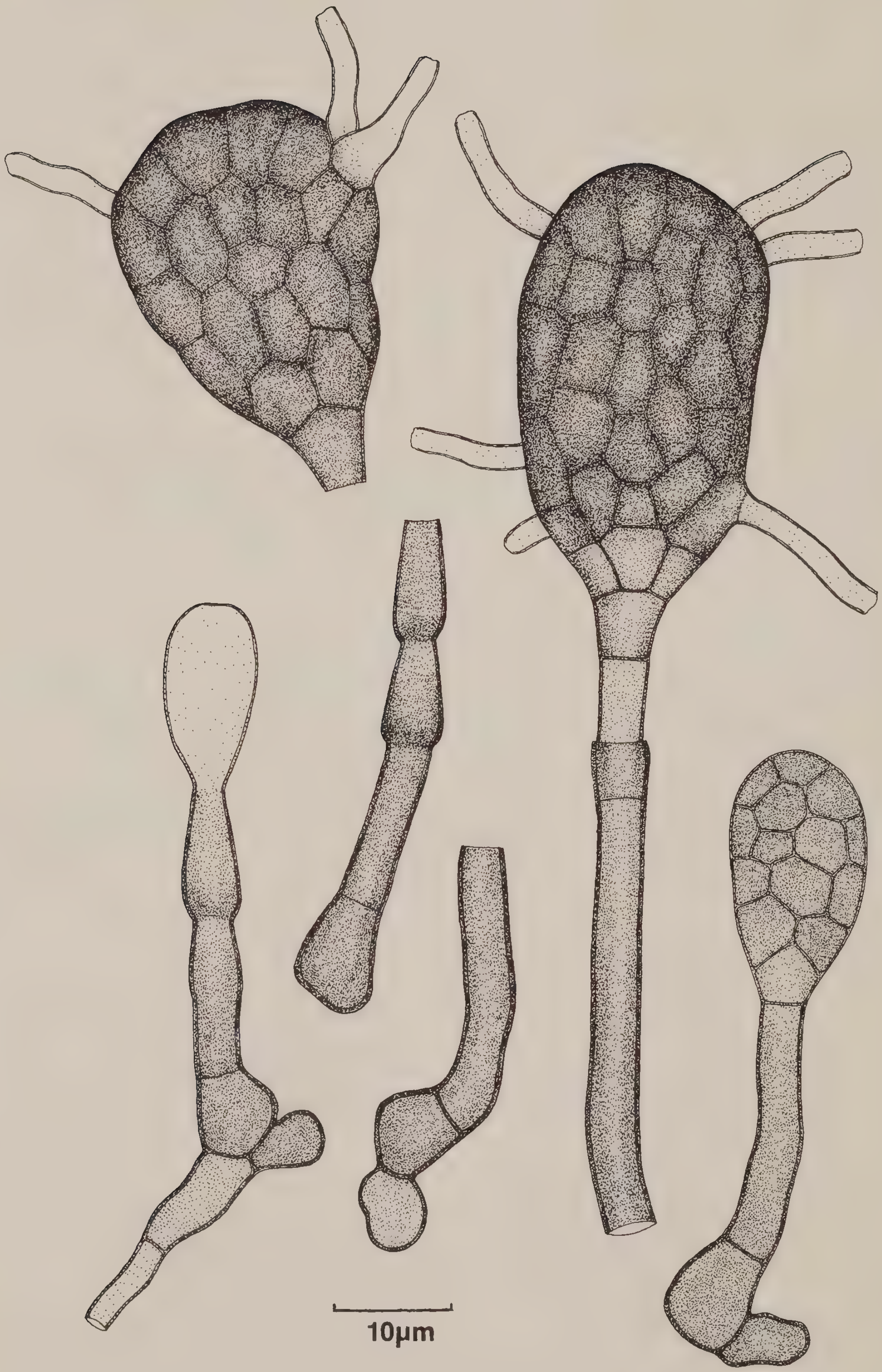

FIGURE 1. *Acrodictys eickerii*

appendicibus 2 - 7, pallide brunneis, 7 - 16µm longis, 2 - 3µm crassis; ad basim truncata.

In ramulis emortuis decorticatis, Debengeni Forest Reserve, Magaebaskloof, N. E. Transvaal, South Africa, August 17, 1979, R. C. Sinclair, AUA, holotypus.

Colonies effuse, dark brown to black. Mycelium partly superficial, partly immersed in the substratum, composed of branched, septate, pale brown, smooth, 2 - 3µm wide hyphae. Conidiophores macronematous, mononematous, single or in fascicles of two or, rarely, three, unbranched, arising laterally from the hyphae, straight or flexuous, erect, brown or dark brown, smooth, non-septate or septate, up to 40µm long, 5 - 6µm wide, with occasionally up to two terminal successive proliferations. Conidiogenous cells monoblastic, integrated, terminal, determinate, or proliferating percurrently. Conidia solitary, formed singly at the apex of each conidiophore, dry, subglobose or broadly pyriform or somewhat turbinate, muriform, smooth, brown to dark brown, 38 - 64µm long, 22 - 42µm wide, bearing 2 - 7 pale brown appendages distally and laterally, 7 - 16µm long, 2 - 3µm wide; base truncate.

On decorticated twigs; South Africa.

Collection examined: Debengeni Forest Reserve, Magaebaskloof, N. E. Transvaal, South Africa, August 17, 1979, R. C. Sinclair, AUA, holotype.

Acrodictys eickerii is named in honor of Professor Albert Eicker, Department of Botany, University of Pretoria, through whose good offices the collections of hyphomycetes on which these studies are based were made.

Among species of *Acrodictys*, *A. eickerii* resembles both *A. brevicornuta* M. B. Ellis and *A. appendiculata* M. B. Ellis in possessing a number of conidial appendages. It is morphologically quite similar to *A. appendiculata* in particular but differs from it in having much larger conidia, usually more numerous conidial appendages distributed both laterally and distally, and possessing percurrently proliferating conidiophores. In the latter characteristic it resembles several non-appendaged species of *Acrodictys*. In shape of conidia and distribution of appendages *A. eickerii* bears a broad similarity to *Piricauda cochinenis* (Subram.) M. B. Ellis.

Pseudospiropes falcatus sp. nov. (Fig. 2).

Coloniae effusae, olivaceo-brunneae vel fuscae, velutinae vel pilosae. Mycelium immersum, ex hyphis ramosis, septatis, pallide brunneis, levibus, 2 - 3.5µm crassis compositum. Conidiophora macronemata, mononemata, erecta, recta vel leniter flexuosa, crasse tunicata, septata, brunnea, apicem versus pallidiora, laevia, cicatricibus conidialibus praedita, usque ad 190µm longa, 4 - 6µm crassa, basi unterdum ad 8µm inflata. Cellulae conidiogenae

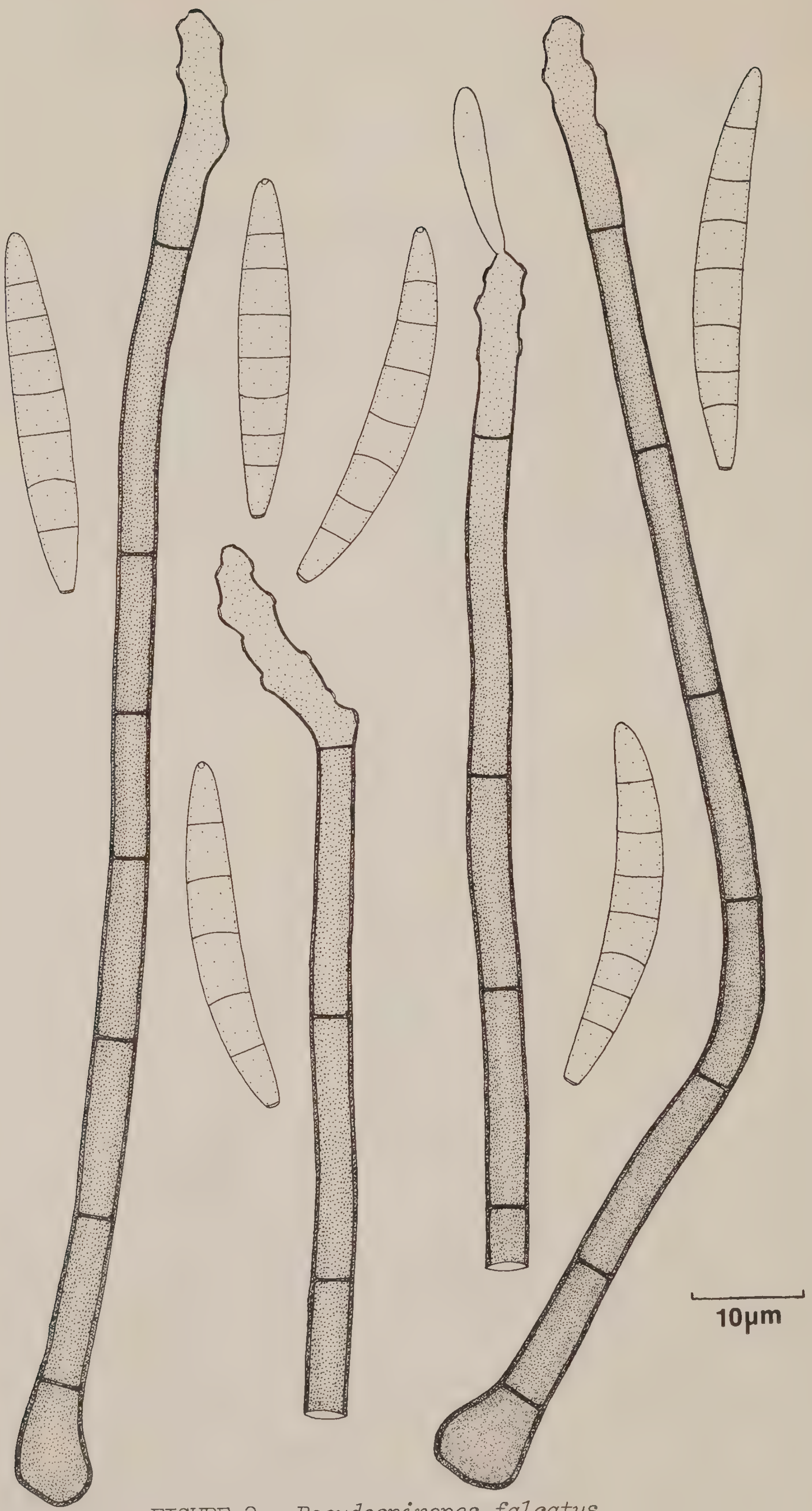

FIGURE 2. *Pseudospiropes falcatus*

polyblasticae, in conidiophoris incorporatae, terminales, sympodiales, cylindricae, usque ad 7 cicatricles. Conidia solitaria, sicca, acropleurogena, simplicia, cylindrica vel fusiformia vel falcata, basi truncata, pallide brunnea, laevia, 5 - 7 septata, 32 - 41 X 4 - 5µm.

In ligno emortuo, Pienaar's River, Pretoria, South Africa, August 13, 1979, R. C. Sinclair, AUA, holotypus.

Colonies effuse, olivaceous brown to dark blackish brown, velvety or hairy. Mycelium immersed, composed of branched, septate, pale brown, smooth, 2 - 3.5µm wide hyphae. Conidiophores macronematous, monomematous, simple, erect, straight or slightly flexuous, thick-walled, septate, brown to pale brown, paler towards the apex, up to 190µm long, 4 - 6µm wide, up to 8µm wide at the swollen base. Conidiogenous cells polyblastic, integrated, terminal, sympodial, cylindrical, bearing a number of thin, flat, small, dark, very slightly protruding scars. Conidia solitary, dry, acropleurogenous, simple, cylindrical to fusiform, most frequently falcate, base narrowly truncate, pale brown, smooth, 5 - 7 septate, often bearing a small, highly refractive spot at the extreme apex, 32 - 41 X 4 - 5µm.

On dead wood; South Africa.

Collection examined: Pienaar's River bank, junction of Bronkhorstspruit Road, Pretoria, South Africa, August 13, 1979, R. C. Sinclair, AUA, holotype.

Pseudospiropes falcatus is easily distinuishable from other species of *Pseudospiropes* possessing relatively thin-walled, septate conidia, as opposed to the thick-walled, pseudoseptate conidia of *P. nodosus* (Wallr.) M. B. Ellis and *P. simplex* (Kunze) M. B. Ellis, by the length and shape of its conidia. It most closely resembles *P. rousselianus* (Mont.) M. B. Ellis, which also, incidentally, has often a small refractive spot at the apex of its conidia.

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I thank my former graduate student, Mr. Robert C. Sinclair, for the opportunity to examine collections made by him in South Africa. Dr. J. Leland Crane kindly reviewed the manuscript.

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MYCOTAXON

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NOTES ON HYPHOMYCETES. XLIII.
CONCERNING *CHAETOPSINA ROMANTICA*.

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ABSTRACT

Chaetopsina romantica Rambelli and Lunghini is described and illustrated from a collection on leaves of *Magnolia virginiana* L. in Alabama. The collection represents the second record of the fungus and the first from North America.

INTRODUCTION

The genus *Chaetopsina* Rambelli, which remained monotypic for well over a decade after its establishment in 1965, has had a number of species added to it during the 1970's (Matsushima, 1971; Rambelli and Lunghini, 1976, 1979; Sutton and Hodges, 1976; Morgan-Jones 1979). When described, each species was known from but a single collection and this still remains the case with the majority. The exceptions are the type species, *C. fulva* Rambelli, which is now known from dead leaves in Italy (Rambelli, 1956), Papua-New Guinea (Matsushima, 1971), U.S.A. (Pirozynski and Hodges, 1973), Japan (Matsushima, 1975), Taiwan (Matsushima, 1980) and from soil in Canada (Barron, 1968), and *C. ramifera* Matsushima, which is known from dead leaves in Papua-New Guinea (Matsushima, 1971), Brazil (Sutton and Hodges, 1976), Taiwan (Matsushima, 1980) and from dead wood in the Ivory Coast (Rambelli and Lunghini, 1979). We have no knowledge of the geographical distribution of the other taxa.

Chaetopsina romantica Rambelli and Lunghini was described from unidentified bark fragments of forest floor litter collected in the Tai National Forest, Ivory Coast, Africa, in 1976. It has not, to my knowledge, been reported elsewhere to date. I have, however, encountered the fungus during an investigation of the microfungi occurring on leaf litter of sweetbay (*Magnolia virginiana* L.) in Alabama.

A comparison of the Alabama material with the description provided by Rambelli and Lunghini (1979) indicates a number of important

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characteristics of the conidiogenous cells not documented by these authors as well as a number of morphological features and variabilities. A new description and illustration of the fungus is therefore presented here.

TAXONOMIC PART

Chaetopsina romantica Rambelli and Lunghini, Trans. Br. mycol. Soc. 72: 491, 1979 (Fig. 1).

Colonies effuse, hairy, glistening, brown to dark brown. Mycelium partly superficial but most immersed, composed of septate, branched, very pale brown, smooth, 2 - 3.5µm wide hyphae. Setae formed directly from the mycelium or from a cluster of a few to many swollen, subglobose, yellowish to mid brown, thick-walled, 4 - 6µm wide cells, scattered, solitary or sometimes in pairs, erect, mostly straight, verruculose distally, thick-walled, brown, tapering gradually towards the apex, bearing up to 16 septa, septae at closer intervals near the apex, up to 370µm long, 8 - 10µm wide in the middle part, up to 14µm wide at the slightly bulbous base. Conidiogenous hyphal elements arising laterally towards the middle of the setae or at various levels in the distal portion, or terminally, simple or branched, subhyaline to very pale yellowish, cylindrical, smooth-walled, septate, of varying length. Conidiogenous cells mono or polyphialidic, discrete, determinate or nondeterminate, narrowly ampulliform or frequently assuming an hourglass-shaped configuration, borne terminally or laterally on the conidiogenous hyphae or, occasionally, directly from the setae, bearing a discernible but non-flaring collarette, 7 - 18 X 2 - 2.5µm. Sometimes integrated, intercalary cells of the conidiogenous hyphae can be fertile. Conidia enteroblastic, hyaline, aseptate, straight, smooth, cylindrical, obtuse at each end, 7 - 9 X 1.5 - 2µm.

On bark and leaves; Africa and North America.

Collection examined: on dead leaves of *Magnolia virginiana* L., off Rt. 50, 5ml south of Lafayette, Chambers County, Alabama, July 26, 1979, G. Morgan-Jones, AUA.

The binomial *Chaetopsina romantica* is being used for the Alabama collection advisedly. Although the conidia are identical the conidiogenous apparatus differs substantially from that in the type description. Of particular note is the sometimes indeterminate nature of the conidiogenous cells which, as a result of sympodial extension, increase in length, produce several conidiogenous loci and thereby become polyphialidic. The peculiar hourglass shape of some conidiogenous cells is evident in the illustration provided by Rambelli and Lunghini (1979) but no mention of this is made in their description. This type of configuration is usually evidence for percurrent proliferation of phialides but no discontinuity in the periclinal wall at the point of constriction is discernible under the resoulution limits of the light microscope in this instance. The presence of conidiogenous cells that are polyphialidic in nature, as well as fertile intercalary cells in the conidiogenous hyphal

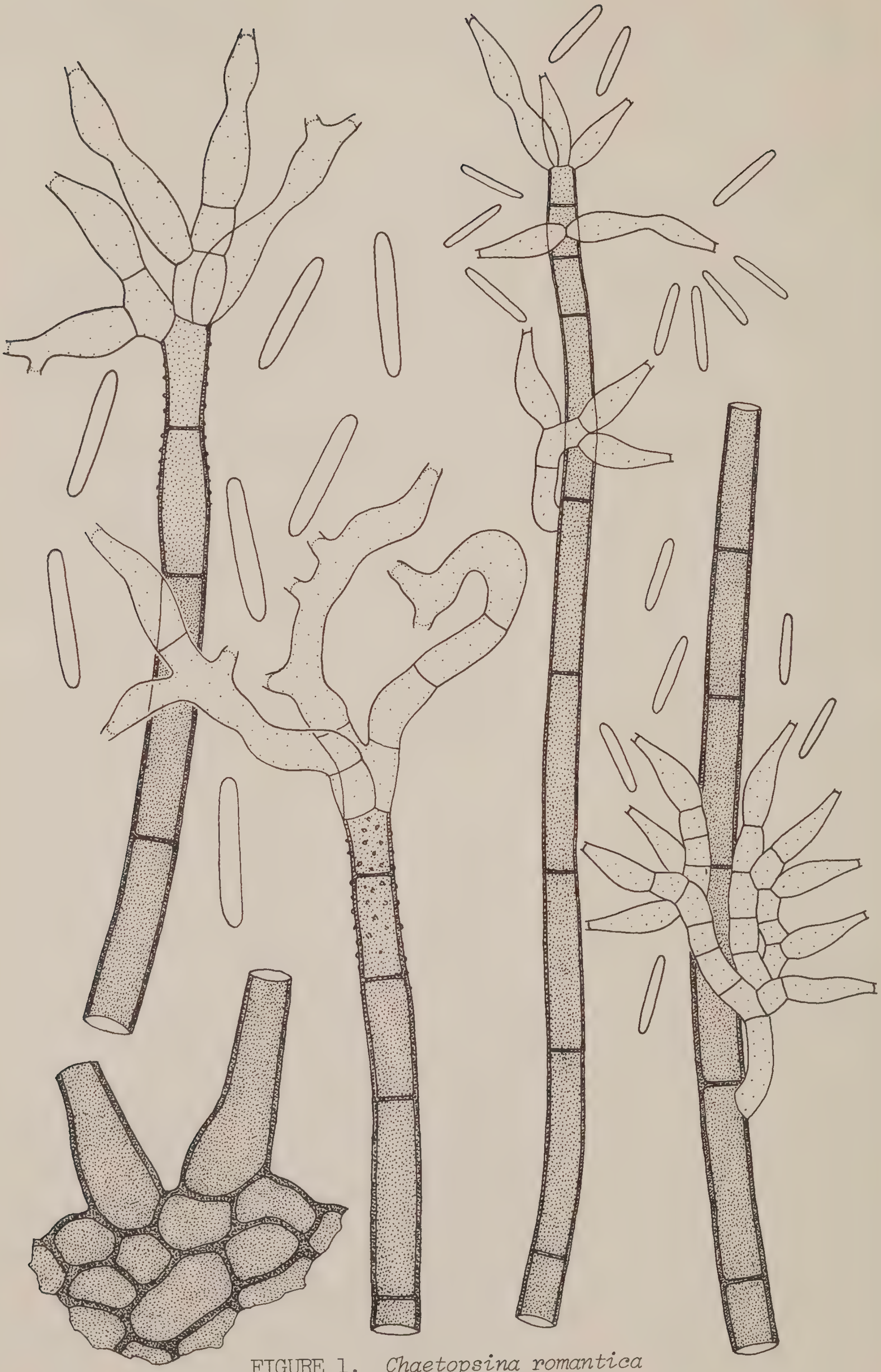

FIGURE 1. *Chaetopsina romantica*

elements, in the Alabama material may reflect especially favorable environmental conditions rather than any fundamental genotypic variance. This does, however, raise a question concerning the distinctiveness of *Chaetopsina*. As Rambelli and Lunghini (1976) have pointed out the possession of polyphialides by *Chaetopsis* Greville was regarded as the main differentiating characteristic between the two genera. *Chaetopsina ivoriensis* Rambelli and Lunghini also possesses polyphialides [Rambelli and Lunghini (1976) illustrate such structures although in their type description the conidiogenous cells are described as being monophialidic]. I should also note in passing that it appears that the phialides of *C. ivoriensis* can proliferate percurrently (there is, in fact, much similarity between the conidigenous apparatus of *C. ivoriensis* and that of the Alabama collection described herein but the conidia of that species are much smaller). In both *Chaetopsis grisea* (Ehren.) Sacc. the type species of *Chaetopsis*, and *Chaetopsina auburnensis* Morgan-Jones conidiogenous cells are sometimes replaced by setose lateral branches. The primary distinction between these two genera lies in the morphology of the lateral, phialide-bearing branches; in *Chaetopsis* they are acutely divergent, robust, and thick-walled towards their point of origin whereas in *Chaetopsina* they are, generally, flexuous and thin-walled, usually orientated more or less parallel to the seta, particularly when borne towards the middle.

ACKNOWLEDGMENT

I thank Dr. Carol A. Shearer, University of Illinois, for reviewing the manuscript.

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PHYCOSYMBIODEMES IN PSEUDOCYPHELLARIA IN NEW ZEALAND

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SUMMARY

Three instances of joined thalli in *Pseudocyphellaria* from New Zealnd are presented. Details of developmental morphology and results of phytochemical investigations are given and discussed in connection with recent findings in other genera. The importance of chemical characters especially, in evaluating influences of different symbiotic algae is underlined. *Phycosymbiodeme* is proposed as a functionally descriptive term for joined thalli occuring most commonly in the suborder Peltigerineae and especially in the families *Peltigeraceae* and *Lobariaceae*.
The new species *P.allanii* D.Galloway, *P.margaretae* D.Galloway, and *P.murrayii* D.Galloway, are described and the new combination *P.rufovirescens* (Church. Bab.) D.Galloway, proposed.

INTRODUCTION

Recent discussions of morphotypes in *Sticta* (James and Henssen 1976), and in *Peltigera* (Brodo and Richardson 1979) expanding earlier accounts of joined thalli in *Sticta* (Wilson 1891, Dughi 1944) and in *Lobaria* (Dughi 1937, Jordan 1972)have made necessary a re-evaluation of the problem of interaction between mycobionts and phycobionts in the lichen symbiosis. Detailed comparative studies on composite thalli in the order Peltigerineae, and in the family *Pannariaceae* (James and Henssen 1975, 1976) showed that both anatomy and morphology of certain taxa in these groups may be influenced by the phycobiont present in the symbiotic system. Different genera of phycobiont exert distinctive morphogenetic pressures (e.g. the development of stalked fronds) on the same mycobiont, thereby stimulating the production of joined thalli under certain, usually favourable, ecological conditions. Studies of Brodo and Richardson (1979) on the development of subfoliose cephalodia in *Peltigera aphthosa* and *Coccomyxa*-containing lobes growing from them, support the notion of differing lichen morphologies resulting from a particular mycobiont associating with different phycobiont genera in a single autonomous plant. Further they discuss a deviating secondary metabolism as a possible cause of two different symbiotic unions, a speculation having important taxonomic implications.

In *Pseudocyphellaria* Vainio, in New Zealand (Galloway in prep.) several species pairs exist, comprising a fertile (parent) species, and a corresponding asexual (derived) species possessing either isidia or soredia but usually rarely or never fertile. Examples of usually such species pairs are *P. homoeophylla* (fertile)-*P. delisea* (isidiate) and *P. faveolata* (fertile)-*P. granulata* (sorediate). It is thought that the asexual species (often more widely distributed) is derived from the sexual species, and from an evolutionary point of view is regarded as having arisen at some time subsequent to the emergence of the fertile parent species. Interestingly enough, in the case of *P. delisea* which is widespread in New Zealand, the subantarctic islands, south-eastern Australia and in southern South America, the fertile parent species *P. homoeophylla*, is known only from New Zealand. Besides conventional species pairs in *Pseudocyphellaria*, field studies disclosed also the existence of joined thalli composed of closely similar species apparently differing mainly in the presence of a green or blue-green phycobiont. Subsequently, free-living individuals of the blue-green phycobiont-containing species were discovered and are described in this paper since the green phycobiont-containing species in all cases was already named.

In at least five instances joined thalli are known and doubtless more will be found in New Zealand and elsewhere. In this paper observations on three of these are presented together with details of their chemistry , morphology and taxonomy.

James and Henssen (1976 pp 53-56) record evidence of light and humidity giving rise to morphotypic variation in species of *Pseudocyphellaria* (*P. punctulata* and *P.junghuhniana*) in south-east Asia, with *P.punctulata* (green phycobiont) occuring in high light situations in canopy branches and *P. junghuhniana*(blue-green phycobiont) growing in low-light, high humuidity sites at the base of the tree or on adjacent rocks. Between the two extremes of habitat and microclimate there exist a series of intermediates which "....freely develop pycnidia and ascocarps and, significantly,there is relatively little alteration in their respective thalline anatomy and morphology according to which of the algal partners predominates ...." (James and Henssen p.55). The situation with joined thalli found in New Zealand is somewhat different since both free-living green-phycobiont, and blue-green-phycobiont species can exist in similar habitats alongside examples of joined thalli, and there doesn't seem to be any particular microclimate factor potentiating the formation of joined thalli. However it must be noted that the joined thalli so far known are all from moist, evenly humid, habitats in moderate shade either close to sheltered streams, or in ± deep gorges or in areas of wet forest on slopes often shronded in cloud. Since both green, and blue-green phycobiont-containing components of joined thalli are capable of an independent existence and have certain characters which allow their taxonomic separation they are given, for the time being, separate species names. The taxonomic status of the joined thalli is still a matter for major discussion and no single name can be ascribed to it under the existing rules of Botanical Nomenclature. In our treatment we recognise the names of the two components (which appear to differ mainly in terms of the phycobiont present) within quotation marks, since it cannot be proved unequivocally (although it is strongly suspected) at present that the same fungus is common to the two components of the joined thalli. It is quite possible that already well known green phycobiont-,or blue-green phycobiont-containing species will be found joined to similar species differing in the nature of the phycobiont. Such a phenomenon seems to occur with some frequency in the families *Peltigeraceae* and *Lobariaceae*, especially in areas of rich speciation where it appears that species are in the process of emerging to exploit a particular microhabitat and/or microclimate.

TERMINOLOGY

The use of *chimera* (James 1975) and *chimeroid association* (Brodo and Richardson 1979) is misleading and best avoided. Winkler (1907) first introduced the term to describe plants composed of two or more idiotypes derived from somatic mutation, segregation or grafting. Such a definition cannot be applied to any known lichen thallus. On the other hand the term *morphotype* proposed by James and Henssen (1976) to emphasize the dimorphic character of joined thalli takes into consideration only one aspect of these composite organisms, although admittedly according to our present knowledge, the most striking aspect. We here propose an alternative term *phycosymbiodeme* to encompass all the peculiarities of joined thalli presently known. Swinscow (1977) used the term *phycotype* which is close to the term proposed here, but does not fully agree with our definition. The use here of *deme* rather than *type* as an ending in the terminology proposed above frees the term from any taxonomic or systematic connotation which may inadvertently be placed on it. Deme is a suitably neutral suffix which indicates a specific type of relationship between a group of individuals of a specific taxon, e.g. *chemodeme*, *morphodeme* etc.. It deserves a wider use in descriptive lichenology.

Phycosymbiodeme. In a number of lichens especially in the *Peltigeraceae* and *Lobariaceae* the particular morphological expression of the symbiosis is causally related to the species of symbiotic algae. Natural phycosymbiodemes always occur in pairs and are distinct products of lichenisation of one mycobiont with two different algae, one belonging to the *Cyanophyceae* the other to the *Chlorophyceae*. Any dissimilarity may be caused by physiological and/or morphological and/or anatomical and/or cytological differences between the two lichenised states. If one of the two phycosymbiodemes of a pair contains green algae, and the other blue-green algae then the first one is called a chlorosymbiodeme, the second one a cyanosymbiodeme. *A priori* the quantity of distinguishable algal species in either phycosymbiodeme is not limited.

MATERIAL AND METHODS

MATERIAL

Living material of joined thalli were obtained from several localities in New Zealand and were sectioned within 4-6 weeks of collection. Material of the pair "*P.margaretae/P.pubescens*" came from *Leptospermum* bark, Black Hill, Nelson Lakes National Park (South Island) in 1978, material of "*P.murrayii/P.rufovirescens*" from twigs of *Lophomyrtus bullata*, Mangaotaki River, King Country (North Island) in 1978, and material of "*P.allanii/P.coriacea*" from bark of *Myrsine australis*, Peel Forest, Little Mt Peel (South Island) in 1977.

METHODS

Morphology:Freezing-microtome sections were mounted in lactophenol/cotton-blue. Habitat photographs were taken with a Wild M7 microscope, photographs of micromorphology with a Wild M20 microscope. Scanning electron microscopy of air-dried thallus fragments was performed with an AMR 1200 SEM (Fa. Leitz). Lichen material was attached to stubs without prior chemical fixation and coated with a thin gold layer (*c*.6 x 10^{-4} mm thick)using a sputter coater with gold target as cathode (sputter coater Fa. Balzer, glow discharge in air at 0.05 mbar and 180 volts).

Chemistry: Secondary metabolites were analysed by TLC in solvent systems A,B and C (Culberson 1972). Identification of some lichen compounds by quantitative isolation from thin-layer chromatograms followed the method of Renner and Gerstner (1978). UV/VIS-absorptionspectra were recorded on a DMR 10 spectrophotometer (Fa. Zeiss) and mass spectra on a Varian CH7 masspectrometer (using direct inlet system and PFK as internal standard; energy of the ion beam was 70 eV, ion acceleration voltage was 3 kV). Trimethylamine was detected by gas chromatography on a Varian Aerograph 1400, equipped with a flame ionistaion detector (column: Poropak T; carrier gas: N_2; column temperature: 50°C; injection temperature: 240°C; range: 2×10^{-11} [amps/mv]).

TAXONOMIC PART

Pseudocyphellaria allanii D.Galloway *sp.nov.*

Species corticola Novae Zelandiae *Pseudocyphellariam coriaceam* (J.D.Hook. & Taylor) D.Galloway & P.James, simulans sed pagina superiori plumbea, scabrida, phycobiontis coerulescentibus Nostocaceis differt.

Holotype: New Zealand. Canterbury, Mt Peel, on track to Emily Falls, Peel Forest. On fallen *Pseudowintera* on bank of stream, 20 March, 1979. D.J. Galloway, CHR 343256.

Thallus orbicular to spreading, ± entangled, to 18 cm diam., loosely to closely attached, corticolous. Lobes linear-elongate (3-)5-8 (14) mm wide, 1.5 - 6 cm long, ± subcanaliculate, subdichotomously branching, discrete, margins entire, sinuous, slightly thickened below, faintly white-pubescent towards apices. Upper surface dark greyish-blue to blue-green, tinged brownish at margins when wet, pale fawnish-grey when dry, minutely scabrid, coriaceous, uneven or very slightly wrinkled-undulate, without isidia, soredia or pseudocyphellae. Medulla white. Phycobiont blue-green, *Nostoc*. Lower surface densely tomentose to margins, occasionally glabrous centrally, pale

buff at margins, dark brown to black centrally, tomentum thick, silky, pale whitish to dark brown, occasionally in scattered, squarrose tufts. Pseudocyphellae white, scattered, conspicuous, round to irregular, 0.5 - 2.5 mm wide, plane to concave with a rised margin at maturity, often sunk in tomentum.
Apothecia not seen. Pycnidia sparse to frequent, immersed, 1.5 mm diam., visible as hemispherical swellings on the lower surface.
Chemistry: 7β-acetoxyhopane-22-ol and hopane-15α-22-diol.

Specimens examined: New Zealand. South Island. Canterbury: Peel Forest, *D.J.Galloway* (CHR)

P.allanii is very closely related to *P.coriacea* and often grows attached to this species. It has so far been found only at Peel Forest on the eastern slopes of Mt Peel. Here it most commonly occurs as an epiphyte of *Myrsine australis* and when wet is readily distinguished from *P.coriacea*. It associates with *P.episticta* and *P.homoeophylla* but its ecology is still poorly known. It is named for Dr H.H.Allan, first Director of Botany Division, D.S.I.R., who in the 1920's described the vegetation of Mt Peel, and who later promoted interest in New Zealand lichens.

Pseudocyphellaria margaretae D.Galloway *sp.nov.*

Species corticola Novae Zelandiae *Pseudocyphellariam pubescens* (Müll. Arg.) D.Galloway & P. James, simulans, sed lobis imbricatis, rotundatis, pagina superiori plumbea, non faveolata, tomento sericea dense obtecta, phycobiontis coerulescentibus Nostocaceis differt.

Holotype: New Zealand. Nelson. Lake Rotoiti, Nelson Lake National Park, Peninsula Walk, on bark of *Leptospermum ericoides*, 29 February, 1980. *D. J. Galloway* , CHR 343279, Isotype in BM.
Thallus orbicular, rosette-forming to spreading, 6-10 (-16) cm wide, loosely attached, corticolous. Lobes short, rounded, 0.3 - 0.8 mm wide, imbricate or contiguous, margins entire, sinuous, shallowly incised, often subascendent, densely white tomentose. Upper surface dark livid leaden-grey or greyish-brown when wet, pale brownish-grey

or pinkish-fawn when dry, ± uniformly tomentose, tomentum long, white, silky, cortex below tomentum smooth, undulate, uneven, shining, never scabrid. Medulla white. Phycobiont blue-green, *Nostoc*. Lower surface pale brownish or whitish at margins, dark brown centrally, irregularly ridged or wrinkled-faveolate towards margins, ± uniformly tomentose, tomentum thick, whitish, silky, uneven, often developing in long, tufted fascicles towards margins. Pseudocyphellae yellow, tiny, 0.1 -0.3 mm diam., scattered or frequent, sunk in tomentum.
Apothecia not seen.
Chemistry: tenuiorin, methyl gyrophorate(±), methyl lecanorate, methyl evernate, pulvinic dilactone, pulvinic acid, calycin, norstictic, constictic, cryptostictic and stictic acids, hopane-15α-22-diol, hopane-6α,7β,22-triol.

Specimens examined: New Zealand. North Island. Hawkes Bay: Kuripapango, *J.K.Bartlett* (BM). South Island. Nelson: Cobb Valley, *J.K.Bartlett* (CHR 266031), Cobb Dam, *J.K.Bartlett* (CHR 266029), Lake Rotoiti, West Bay, *D.J.Galloway* (CHR 343216), St Arnaud, Black Hill, *D.J.Galloway*(CHR 343217, 343274), Tophouse, *W.Martin* (CHR 375474).

P.margaretae is a very characteristic species apparently most common in ± subalpine habitats in north-west Nelson, New Zealand. It is an epiphyte of *Leptospermum ericoides*, *L.scoparium* and *Olearia avicennifolia* in habitats modified by fire. It is tolerant of moderate shade and is found in areas of high rainfall and humidity. Although often reaching a considerable size it is not a common lichen in the habitats in which it grows. It associates with the following lichens: *Anzia jamesii*, *Nephroma australe*, *N.cellulosum*, *N.lepidophyllum*, *Pannoparmelia angustata*, *P.wilsonii*, *Pseudocyphellaria carpoloma*, *P.colensoi*, *P.coronata*, *P.crocata*, *P.granulata*, *P.neglecta*, *P.pubescens*, *P.rubella*, *Psoroma euphyllum*, *P.durietzii* and *P.pallidum*.
It is related to *P.pubescens* and the two species have been found attached to each other. However it differs from *P.pubescens* in the following respects: the lobes are shorter, and more rounded-imbricate, the upper surface is not visibly faveolate or even markedly ridged, the surface of the lobes is uniformly tomentose and the colour

of the upper surface when wet is a livid, leaden-grey-brown, because of the presence of the blue-green phycobiont. In contrast, *P.pubescens* is conspicuously green when wet, has longer and narrower lobes which are faveolate-ridged, the upper surface is often glabrous and the cortex ± distinctly scabrid. It is often fertile, and the marginal apothecia have black discs usually covered with a grey-white pruina. *P.margaretae* has not yet been found fertile.
It is named for Mrs Margaret Bulfin (née M.J.A. Simpson) who has worked for many years on the vegetation and flora of the Nelson Lakes National Park.

Pseudocyphellaria murrayii D.Galloway *sp. nov.*

Species corticola Novae Zelandiae *Pseudocyphellariam rufovirescens* (Church.Bab.) D.Galloway*, simulans sed pagina superiori plumbeus vel cinerascens, undulata vel subfaveolata, maculata, phycobiontis coerulescentibus, Nostocaceis, subtus tomento sericea dense obtect, differt.

Holotype: New Zealand. South Auckland. Mangaotaki Reserve, King Country near Pio Pio. On twigs of *Griselinia littoralis* in deep shade. D.J.Galloway, 9 June, 1978, CHR 343163. Isotype in BM.
Thallus lobate-foliose, spreading, in entangled clones, 5-15 (-30) cm diam., loosely attached, corticolous. Lobes linear-elongate, rather narrow, 3-12 mm wide, expanding towards apices, ± subdichotomously branching, complex, imbricate centrally, discrete, ± subascendent at apices, margins entire, slightly thickened below, occasionally with

*The interpretation of *P.billardierii* (Delise) Räsänen given in Wilkins and James [*Lichenologist 11: 274 (1979)*] and in Galloway and James [*Lichenologist 12: 293 (1980)*]is in error and material discussed therein refers to an endemic taxon which must now be called *P.rufovirescens* (Church.Bab.) D.Galloway, *comb. nov.* Basionym: *Sticta richardi* var. *rufovirescens* Church.Bab., in J.D. Hook., *Fl.Nov. Zel.2: 278 (1855)*.Lectotype: New Zealand. South Island, Akaroa. *Hombron*, BM ex PC!

rounded to elongate white pseudocyphellae, apices truncate or furcate. Upper surface smooth, glabrous, even or subundulate, rarely very shallowly faveolate, ridges smooth, indistinct, without isidia, pseudocyphellae or soredia, conspicuously and irregularly white-maculate (x 10 lens),dark slate-grey to bluish-grey when wet, pale greenish-grey suffused brownish when dry. Medulla white. Phycobiont blue-green, *Nostoc*. Lower surface pale brownish-pink, wrinkled-striate centrally, ± evenly tomentose to margins, tomentum pale, whitish, short, even, lobe apices sometimes glabrous, whitish, wrinkled-bullate, shining. Pseudocyphellae round to irregular, common, plane, intense white, 0.1 - 1 - 2 mm diam., conspicuous.

Apothecia very rare, marginal, subpedicellate, 0.5-2.0 mm diam., disc glossy, coriaceous, dark chestnut-brown to black, epruinose, margins pale pinkish-brown, corrugate-striate to verrucose, ± inflexed and obscuring disc at first becoming ± coronate or denticulate to excluded at maturity, thalline exciple coarsely verrucose-scabrid, minutely tomentose, whitish to dark brownish-pink or red-brown. Epithecium 13-22 µm thick, yellow-brown, of thickened, conglutinate tips of paraphyses. Hymenium colourless 40-65 µm tall. Paraphyses dense, straight, simple, 1.5 µm thick, apices clavate, red brown or yellowish-brown, to 5 µm thick. Asci and ascospores not seen.

Chemistry: 7β-acetoxyhopane-22-ol and hopane-15α-22-diol.

Specimens examined: New Zealand. North Island. South Auckland: Kauaeranga River, *J.K.Bartlett* (Herb Bartlett), Kaimai Range, *J.K.Bartlett* (CHR 343298), Mangaotaki River, *D.J.Galloway* (CHR 343277), Hawke's Bay: Road to Lake Tutira, *W.Martin* 5484 (CHR 375498), Napier-Taupo Road near Tarawera, *J.K.Bartlett* (Herb.Bartlett), Wellington: Erua Swamp, *J.K.Bartlett* (CHR 343207), South Island. Nelson: Cobb Ridge, *J.K.Bartlett* (CHR 343162), Canterbury: Mt Sinclair Reserve, Banks Peninsula, *D.J.Galloway* (CHR 343209), Southland: Forest Hill, *J.Murray* (BM).

P.murrayii has a wide distribution in New Zealand though it is local and rather sparse in presently known habitats. It is an epiphyte of *Dracophyllum subulatum*, *Griselinia littoralis*, *Lophomyrtus bullata*, *Nothofagus menziesii* and *Weinmannia racemosa* in areas of high humidity and moderate to dense shade. It associates with the following lichens:

Coccocarpia erythroxyli, Degelia gayana, Erioderma neozelandica, Hypotrachyna sinuosa, Lobaria retigera, L.scrobiculata, Pannaria fulvescens, Parmelia amphibola, Leioderma pycnophorum, Physma chilense, Polychidium contortum, Pseudocyphellaria aurata, P.crocata, P.episticta, P.faveolata, P.hookeri, P.intricata, P.psilophylla. P.rufovirescens, P.subvariabilis, Sticta latifrons and *Sticta weigelii.*
It is closely related chemically and morphologically to *P.rufovirescens* and the two species have been found attached (joined material comes from Mangaotaki River (North Island) and Mt Sinclair Reserve (South Island) only). When growing independently it is separable from *P.rufovirescens* in the smoother, undulate, very seldom faveolate lobes which are expanded at the apices, the leaden-grey colour when wet because of the presence of blue-green phycobiont, the consistent development of a ± uniform tomentum on the lower surface, and the dark brown to black apothecial discs with corrugate-striate to verrucose margins and tomentose exciple. In *P.rufovirescens* tomentum on the lower surface is very rudimentary and ± restricted to central parts of mature lobes, margins and apices being regularly galbrous,white and shining. Also the pseudocyphellae of *P. rufovirescens* are smaller, more pocklike and scattered and not conspicuous and large as they are in *P. murrayii*. *P.murrayii* is named for the late Dr James Murray of Otago University, New Zealand who first became interested in New Zealand's lichens through his chemical studies in *Pseudocyphellaria.* He was engaged in monographing *Sticta* and *Pseudocyphellaria* at the time of his death (1961), and made the first collections of *P.murrayii* from New Zealand in January 1957.

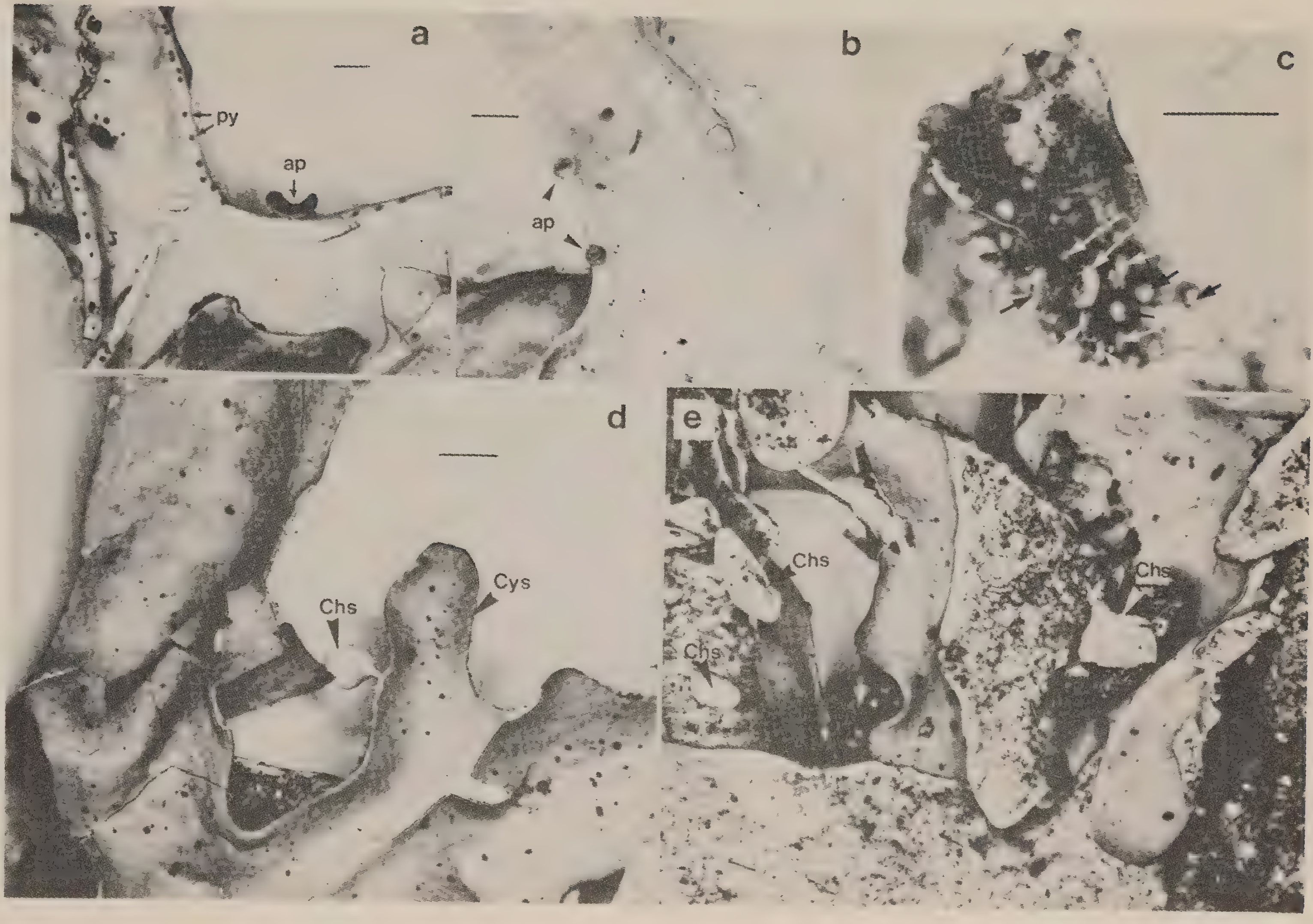
RESULTS

Morphology of phycosymbiodeme development

In the three phycosymbiodemes investigated the chlorosymbiodeme originates from the cyanosymbiodeme. In the pair "*P.margaretae/P.pubescens*", the

chlorosymbiodeme (*P.pubescens*) often arises from the upper cortex and is formed laminally. However, marginally developing chlorosymbiodemes and those originating from the lower surface of *P.margaretae* may also be observed. By contrast in the pair "*P.murrayii/P.rufovirescens*" and "*P.allanii/P.coriacea*", laminally developing chlorosymbiodemes were not seen. Most frequently the chlorosymbiodemes of these pairs form on the lower cortex and along the margins. Critical observations of both cyanosymbiodemes disclose some notable correlations between morphology and the sites of chlorosymbiodeme emergence:
1. Cyanosymbiodemes with a glabrous upper surface (*P.allanii* and *P.rufovirescens*) show chlorosymbiodeme primordia only on the tomentose lower surface and along the margins. 2. Cyanosymbiodemes with a tomentose upper surface (*P.margaretae*) have chlorosymbiodeme primordia not only on the lower surface and margins but also on the upper surface (figs. 5,6a). The development of chlorosymbiodemes therefore seems to occur in those parts of the cyanosymbiodeme thallus where tissues undergo externally orientated differentiation. The inoculation of appropriate green algal cells is evidently restricted to very young hyphae (fig. 4f). The process of encapsulation may be explained by the accidental close coincidence of green algal cells and young hyphal cells.Active outgrowing of hyphal cells triggered by some stimulus from the algal cells does not appear to be involved since epiphytic green algal cells may sometimes cover large areas of both surfaces of

figure 1: Habitat photographs of the pair "*P.murrayii/P.rufovirescens*"; a,b:"*P.rufovirescens*" (chlorosymbiodeme) bearing young (b) and mature (a) apothecia (ap) as well as pycnidia (py); c: lower surface of "*P. murrayii*" (cyanosymbiodeme)-lobe, with 10 chlorosymbiodeme primordia formed one beside the other; d: lobe of "*P.murrayii*" bearing a young, stalked lobule of "*P. rufovirescens*" which develops marginally; e: lobes of "*P.murrayii*" with young chlorosymbiodemes on the lower surface; chs: chlorosymbiodeme; cys: cyanosymbiodeme; scale: 1mm (e:as in d).


a
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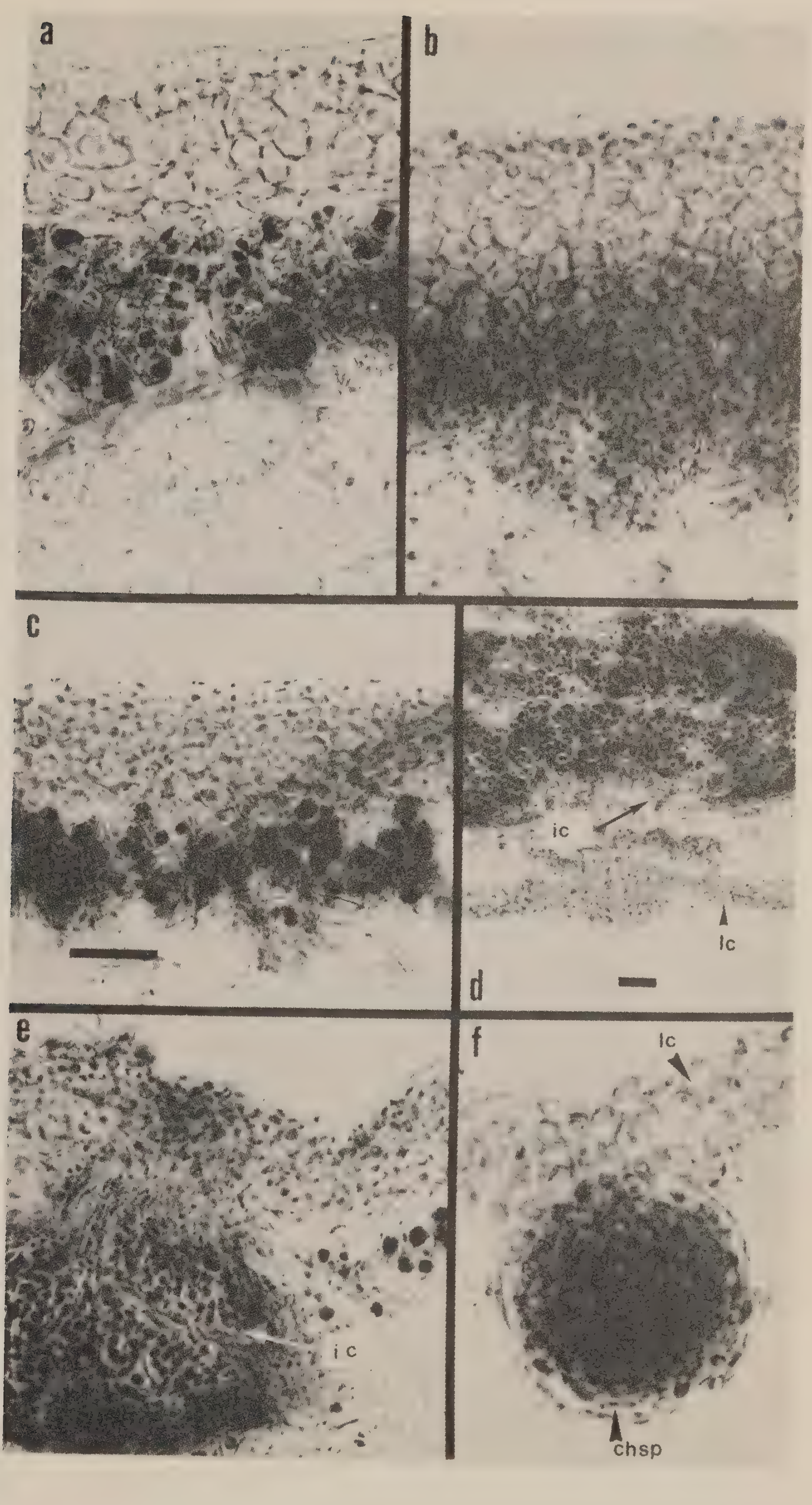
either symbiodeme without producing any effect at all. In all cases studied, chlorosymbiodeme development begins with the contact of very slight hyphae surrounding usually only one or a few algal cells (figs. 4f,6c). These tender hyphae or outermost hyphal cells of the cortex are normal cortical constituents. The first step in chlorosymbiodeme development, once epiphytic green algal cells are recognized by the mycobiont, is the immediate surrounding of the algae by hyphae growing from the cortex of the cyanosymbiodeme (figs. 2f,4c), a process analogous to the early stages of the development of cephalodia in genera of the *Lobariaceae*.

The resulting primordia, regardless of their site of formation are at first nearly spherical (figs. 3c, 4c) and in them the hayphal envelope forms from the very beginning a kind of pseudoparenchymatous cortex. They later elongate and become slightly faltтened (figs. 1d,e, 3b,4e) as the visible chlorosymbiodeme. At the apices of these young lobules an heteromerous arrangement of tissues is evident. Sometimes also the presumptive lower cortex may already have developed pseudocyphellae (fig. 4e). During a period of further growth, with continuously changing micromorphology, a typically organized green-algal-containing lobe with a distinct upper and lower cortex, medulla and algal layer is formed. Whereas the structure of the cortical hyphal cells, the thickness of the cortices, and that of the whole thallus are similar in both phycosymbiodemes, at the site

figure 2: Thallus anatomy of the pair "*P.murrayii/P.rufovirescens*"; a: cross section of "*P.murrayii*" with upper cortex, algal layer and part of the medulla; b,c: cross section of "*P.rufovirescens*" with upper cortex, algal layer and part of the medulla, b: young lobe in close vicinity to "*P.murrayii*", c: mature lobe; d,e: cross section of "*P.rufovirescens*", showing internal cephalodia (ic) developing from the lower thallus surface (d) and exeptionally from the upper thallus surface (e); f: cross section of "*P.murrayii*" with one chlorosymbiodeme primordium (chsp) on the lower cortex (lc); scale in c (representative also of a,b,e,f) and in d: 20 µm.


a
b
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ic
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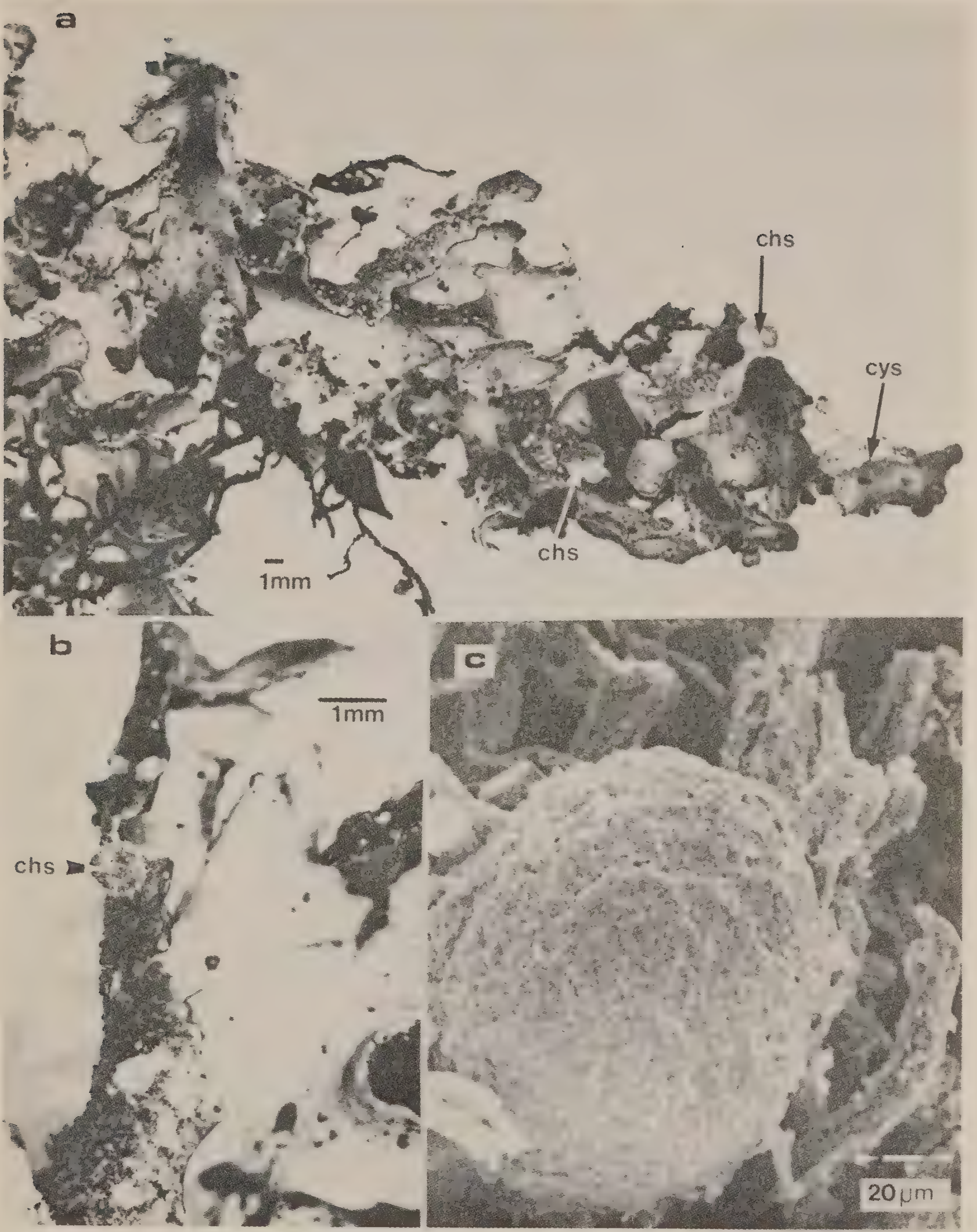
d
e
ic
f
lc
chsp

of attachment these anatomical structures may successively change with continuing growth of the chlorosymbiodeme and its increasing distance from the cyanosymbiodeme. This drifting apart of developmental morphology is best seen in the pair "*P.murrayii/P.rufovirescens*".

At the base of the thallus of *P.rufovirescens* which is very close to the thallus of *P.murrayii* the cells of the cortices are ± isodiametric with large lumina and rather thin cell walls, resembling those of *P.murrayii* (fig.2b). The green algal cells are arranged in a wide-ranging layer with numerous aplanosproangia and free aplanospores accounting for the small size of the algal cells in this region. The green algal layer reaches deep into the medulla and sometimes nearly touches the lower cortex. If the chlorosymbiodeme is attached to the cyanosymbiodeme by a stalk-like transition zone (fig 1d), then this area is devoid of algae and the formation of the upper cortex of the chlorosymbiodeme is seen as a sudden constriction in the cortex of the stalk. With increasing distance from the chlorosymbiodeme's growing tip, the algal layer becomes confined to a thin zone beneath the upper cortex (fig. 2c), the algal cells being closely packed and only rarely developing aplanosporangia. The upper cortical cells are no longer exclusively isodiametric (fig. 2c).The outer layer especially consits of periclinally orientated hyphal elements with small cell lumina and thickened cell walls. The lower cortex develops a sparse tomentum. In this zone internal cephalodia may develop (fig. 2d). Exceptionally, cephalodia originating from the glabrous upper surface are formed (fig. 2c). In contrast to the cyanosymbiodeme,the chlorosymbiodeme bears both apothecia and pycni-

figure 3: Habitat and SEM-photographs of the pair "*P. allanii/P.coriacea*"; a: greater part of "*P.allanii*" (cyanosymbiodeme)-thallus with lobules of "*P.coriacea*" (chlorosymbiodeme); b: young lobule of "*P.coriacea*" developing marginally from "*P.allanii*"; c: SEM-photograph of a chlorosymbiodeme primordium on the lower cortex of "*P.allanii*" surrounded by hyphae of the tomentum.

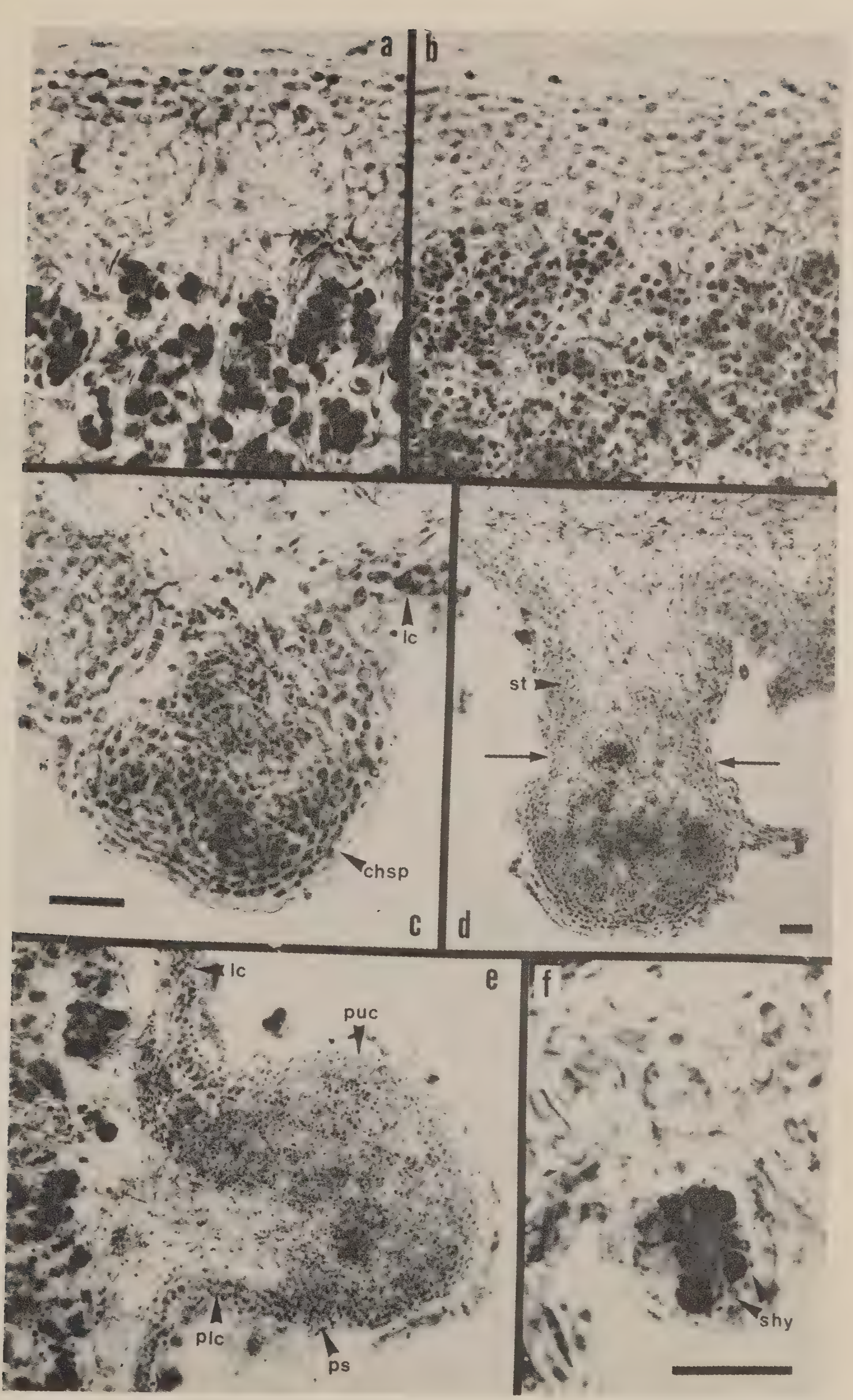

a
chs
cys
chs
1mm
b
1mm
chs
c
20 μm

dia (fig.1a,b).

An inhibitory effect of the developing chlorosymbiodeme in suppressing the formation of further primordia in its immediate vicinity was not demonstrated. Sometimes one may find up to ten chlorosymbiodeme primordia growing close together (fig. 1c), a fact, rendering unlikely the action of any soluble morphogen. The lower cortex of the chlorosymbiodeme does not undergo any remarkable differentiation and is therefore not different from that of the cyanosymbiodeme. The same is true for pseudocyphellae which appear, in the cyanosymbiodeme, to be places of heightened secondary metabolic activity; they are nearly always filled with large amounts of lichen substances.

In order to show the influence of either algae on the formation of particular structures in the phycosymbiodemes of one pair, the development of pseudocyphellae was studied. These are characteristic of species of *Pseudocyphellaria*. The results accord with those of Renner (1980) for *P. freycinetii* and *P.thouarsii*. The first discernable sign in the process of formation of pseudocyphellae is the appearance of typically differentiated medullary hyphae in a circumscribed region of the medulla directly above the lower cortex. These

figure 4: Thallus anatomy of the pair "*P.allanii/P.coriacea*"; a,c,d,e,f: cross sections of "*P.allanii*"; a: anatomy of upper cortex and algal layer; c: chlorosymbiodeme primordia (chsp) growing from the lower cortex (lc) of "*P.allanii*"; d: chlorosymbiodeme growing with a stalk (st) on the lower surface of the cyanosymbiodeme: note that the stalk is devoid of algal cells; the algal-containing tip is slightly separated from the stalk by a constriction (arrows); e: very young lobe of "*P.coriacea*" in which a prospective upper cortex (puc) and prospective lower cortex (plc) may be discerned, the latter having already developed pseudocyphellae (ps); f: very early stage of chlorosymbiodeme formation, showing very tender hyphae of the tomentum (shy) surrounding a few algal cells; b: cross section of "*P.coriacea*" with upper cortex and algal layer; scale in c (representative also of a,b), e (as in d), f: 20 µm.


a
b
lc
chsp
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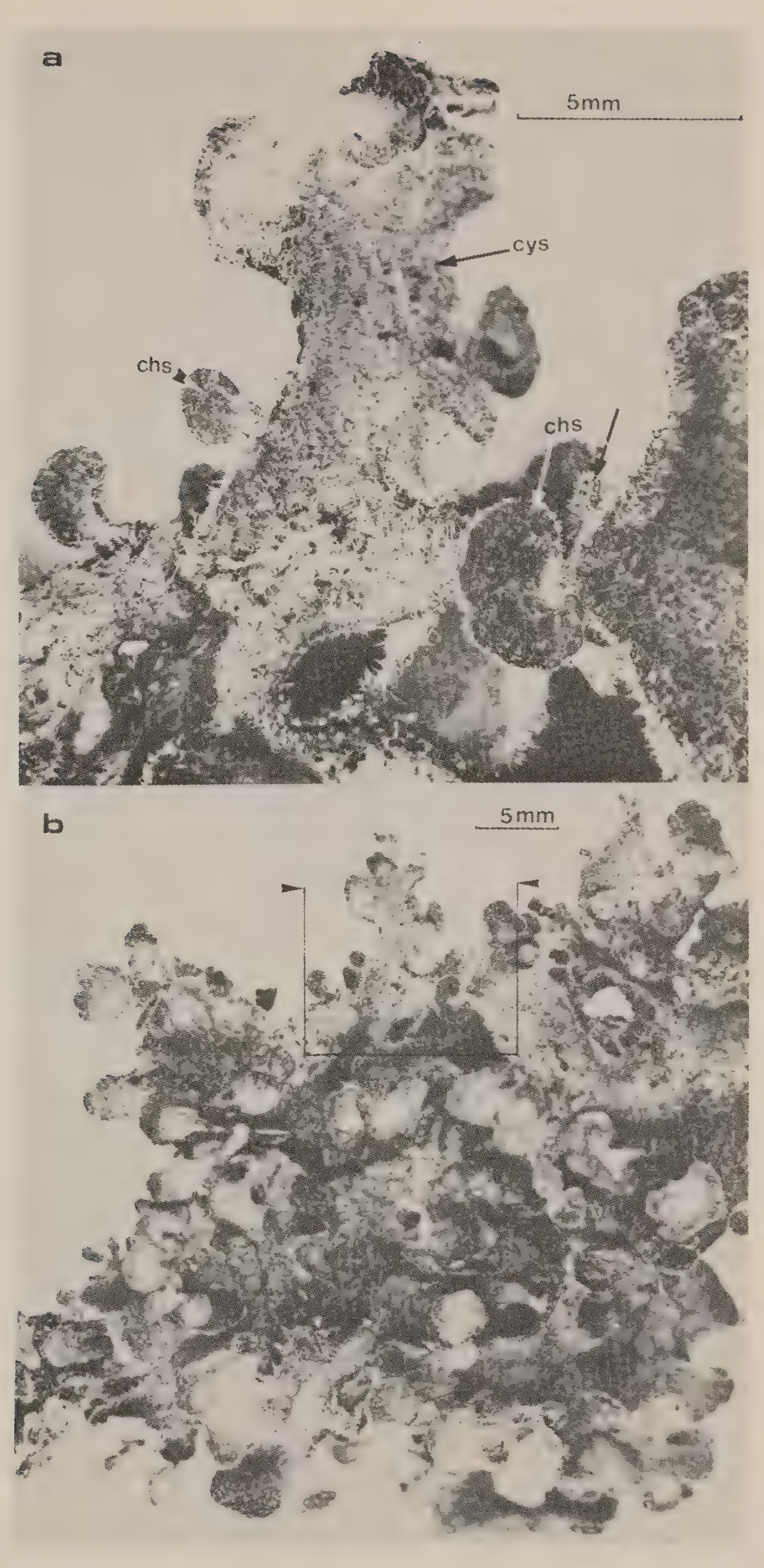
st
d
lc
e
puc
f
plc
ps
shy

hyphal initials consist of branches with short, swollen cells with enlarged lumina(fig.7a). Some of these cells make contact with the lower cortex and forcibly rupture it. While growing through the cortex the hyphal initials further subdivide into many short-articulate cells (fig.7b). The lower cortex first invaginates and later disintegrates probably through gradual lysis (fig.7c). Once the cortex is breached, the medullary hyphae are in free contact with the substrate. Further enlargement of this opening in the cortex is initiated along the border of the pseudocyphellae (fig.7c). In some cases the lower cortex bordering the pseudocyphellae become ± crateriform. In this general scheme of development no differences between species of *Pseudocyphellaria* with green algae and those with blue-green algae can be shown, nor are there differences between the two phycosymbiodemes. Nevertheless the final morphological appearance of these structures, e.g. the frequency, diameter and shape of pseudocyphellae may vary to some extent as is true for cyphellae in *Sticta* (Renner 1980).

The course of chlorosymbiodeme development outlined for the pair "*P.murrayii/P.rufovirescens*" is similar to that of the other two pairs of phycosymbiodemes studied (figs. 3,4,5,6). Although similarities in the development of phycosymbiodemes discussed by James and Henssen (1976) in *Sticta*, and in *Peltigera* by Brodo and Richardson (1979) are obvious, one striking feature distinguishes the pairs of phycosymbiodemes in *Pseudocyphellaria* from these last, viz., the remarkable resemblance of both phycosymbiodemes forming a pair. When dry they are scarcely distinguishable from each other and when wet their morphologies are closely similar but thallus colour ist strikingly different. Clear evidence of different

figure 5: Habitat photographs of the pair "*P.margaretae/P.pubescens*"; b: greater part of "*P.maragaretae*" (cyanosymbiodeme) bearing numerous leaflets of "*P.pubescens*" (chlorosymbiodeme); a: enlarged part of b, giving evidence of the hairy upper cortex of both, the cyanosymbiodeme (cys) and the chlorosymbiodeme (chs).


a
5mm
cys
chs
chs
b
5mm

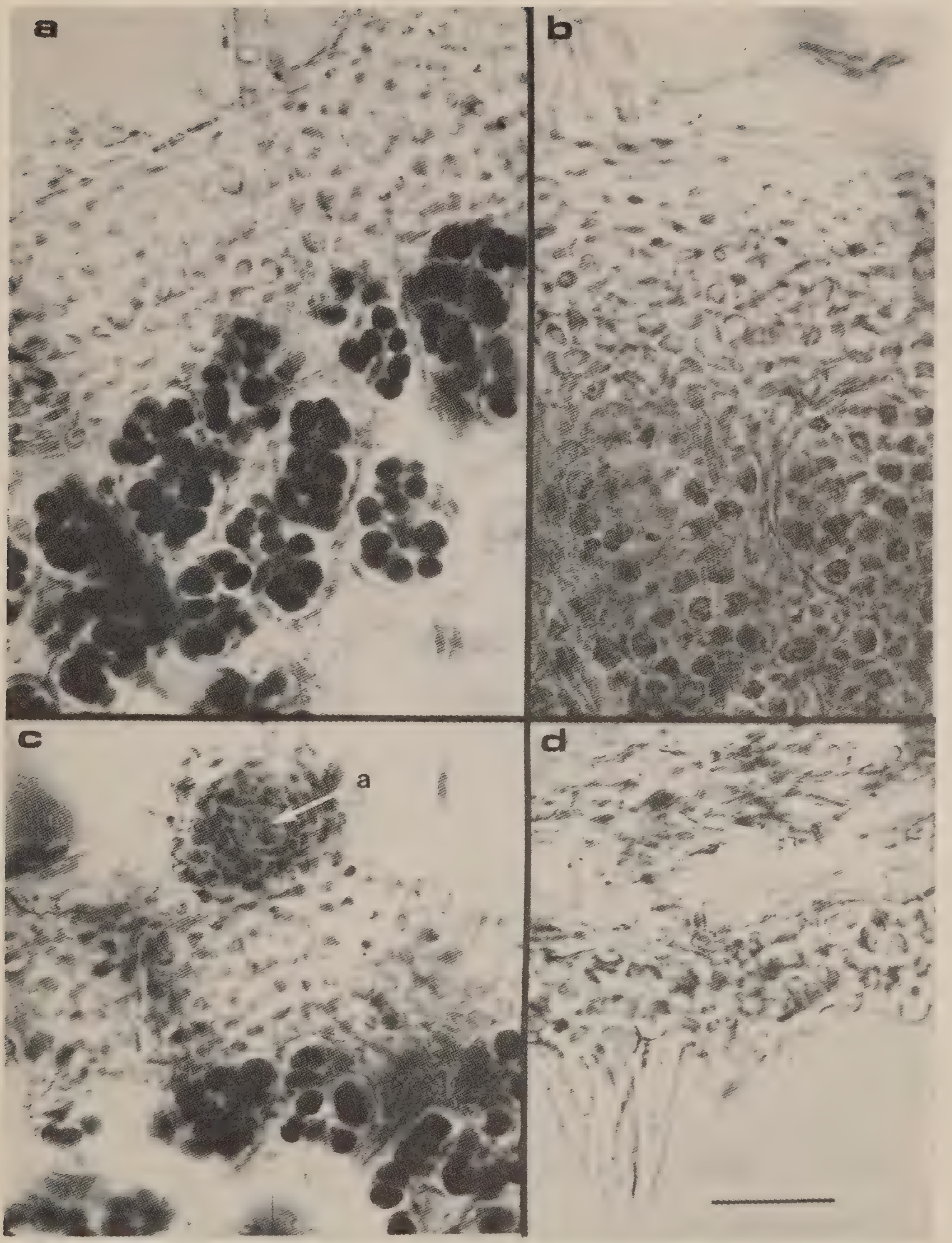
thalli distinguished only by the presence of two kinds of algae is only obtained after cutting the lichen sample.

Chemistry

Fragments of phycosymbiodeme pairs were mechanically isolated under microscopic control and then extracted in cold acetone and chromatographed. Results of ascending TLC in solvent system C are given (fig.9). For "*P.margaretae/P.pubescens*" two-dimensional TLC was necessary to demonstrate the occurence of methyl lecanorate and methyl evernate and of norstictic acid (fig.10). Neutral compounds belonging to the main substances were further characterised by their mass spectra. Detailed data are presented elsewhere (Renner 1980).

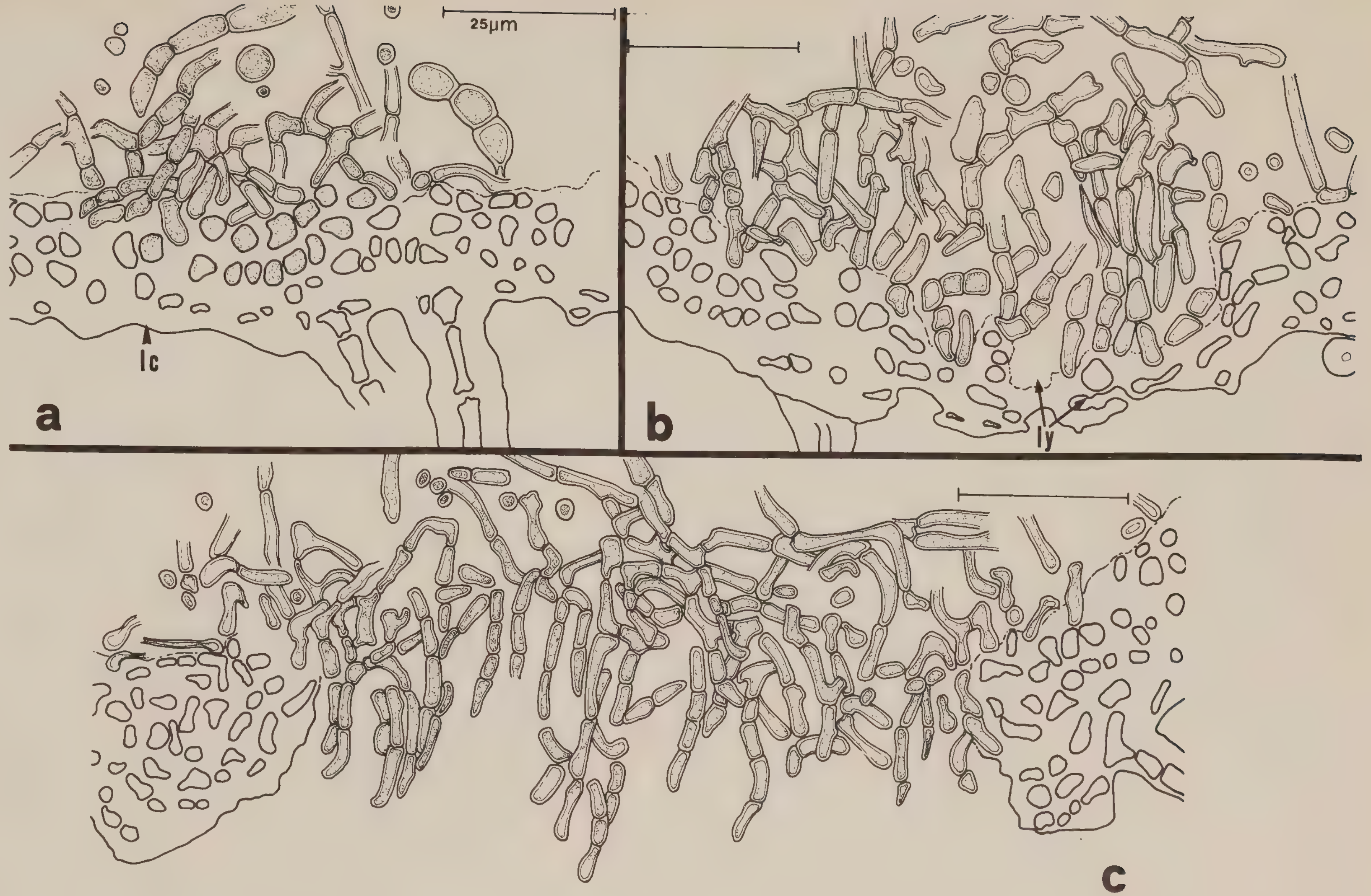
In two pairs of phycosymbiodemes viz., "*P.murrayii/P.rufovirescens*" and "*P.allanii/P.coriacea*" results give strong evidence of two triterpenoids, 7β-acetoxyhopane-22-ol and hopane-15α-22-diol (Wilkins and James 1979, Renner 1980) being present in both joined thalli as well as in either phycosymbiodeme (fig.9). Mass spectral data of 7β-acetoxyhopane-22-ol:
M^{+}: *m/e 486 (not registrated), m/e 468, m/e 453, m/e 428 (not registrated), m/e 393, m/e 249, m/e 206, m/e 205, m/e 207, m/e 189 and m/e 149.*
Mass spectral data of hopane-15α-22-diol:
M^{+}: *m/e 444, m/e 426, m/e 411, m/e 386, m/e 223, m/e 205, m/e 191 and m/e 165.*
The chemistry of the pair "*P.margaretae/P.pubescens*" is more complex, containing substances from

figure 6: Thallus anatomy of the pair "*P.margaretae/P.pubescens*"; a,c,d: cross sections of "*P.margaretae*"; a: upper cortex and algal layer; c: chlorosymbiodeme primordium on the upper cortex, containing two green algal cells(a) being intimately surrounded by hyphae of the tomentum; d: lower thallus cortex with part of the medulla; the structure of the lower cortex is the same as in "*P.pubescens*"; b: cross section of "*P.pubescens*"-lobe in proximity of "*P.margaretae*" with upper cortex and adjoining algal layer; scale in d (representative also of a,b,c): 20 µm.


a
b
c
a
d

all three main biosynthetic pathways involved in secondary metabolism in lichens. Among the neutral constituents, hopane-15α-22-diol and hopane-6α-7β-22-triol were clearly identified (fig.9,10). Mass spectral data of hopane-6α-7β-22-triol:
M^+: *m/e 460, m/e 442, m/e 427, m/e 402, m/e 223, m/e 207, m/e 189 and m/e 149.*
These two triterpenoids of the hopane-series are present in both phycosymbiodemes(fig. 9,10). There is possibly also a trace of 7β-acetoxyhopane-22-ol present in both and one further neutral compound (triterpenoid or sterol ?) of a higher R_f. Products of the shikimic acid pathway, calycin, pulvinic dilactone and pulvinic acid are present in both phycosymbiodemes. Depsidones are norstictic acid, stictic acid, constictic acid and cryptostictic acid, with all compounds present in both thalli. Two tridepsides, tenuiorin and methyl gyrophorate (only in trace amounts) are present in both phycosymbiodemes. The identification of all other depsides remains speculative - they are present only in trace amounts and most likely represent the additional spots, often occuring together with tenuiorin and methyl gyrophorate,viz., methyl evernate, methyl lecanorate and possibly two others. Of the four last-mentioned constituents at least one is not present in *P.pubescens.*
Among volatile compounds of the methylamine series, only trimethylamine was detected by gas chromatography. Aliquots of aqueous extracts of both phycosymbiodemes yielded similar amounts of

figure 7: Schematic outline of pseudocyphellae-development in *P.thouarsii* (taken from Renner 1980);a: very early stage in the development showing strong coloured hyphae in contact with the lower thallus cortex (lc) and inducing cells of the cortex into active growth; b: stage to be characterized as an invasion of the lower cortex by articulated hyphal elements; the cortex is ruptured by the pressure of growing hyphae and lysis (ly); c: young pseudocyphella, with hyphae directly exposed to the substratum.


25µm
lc
a
b
ly
c

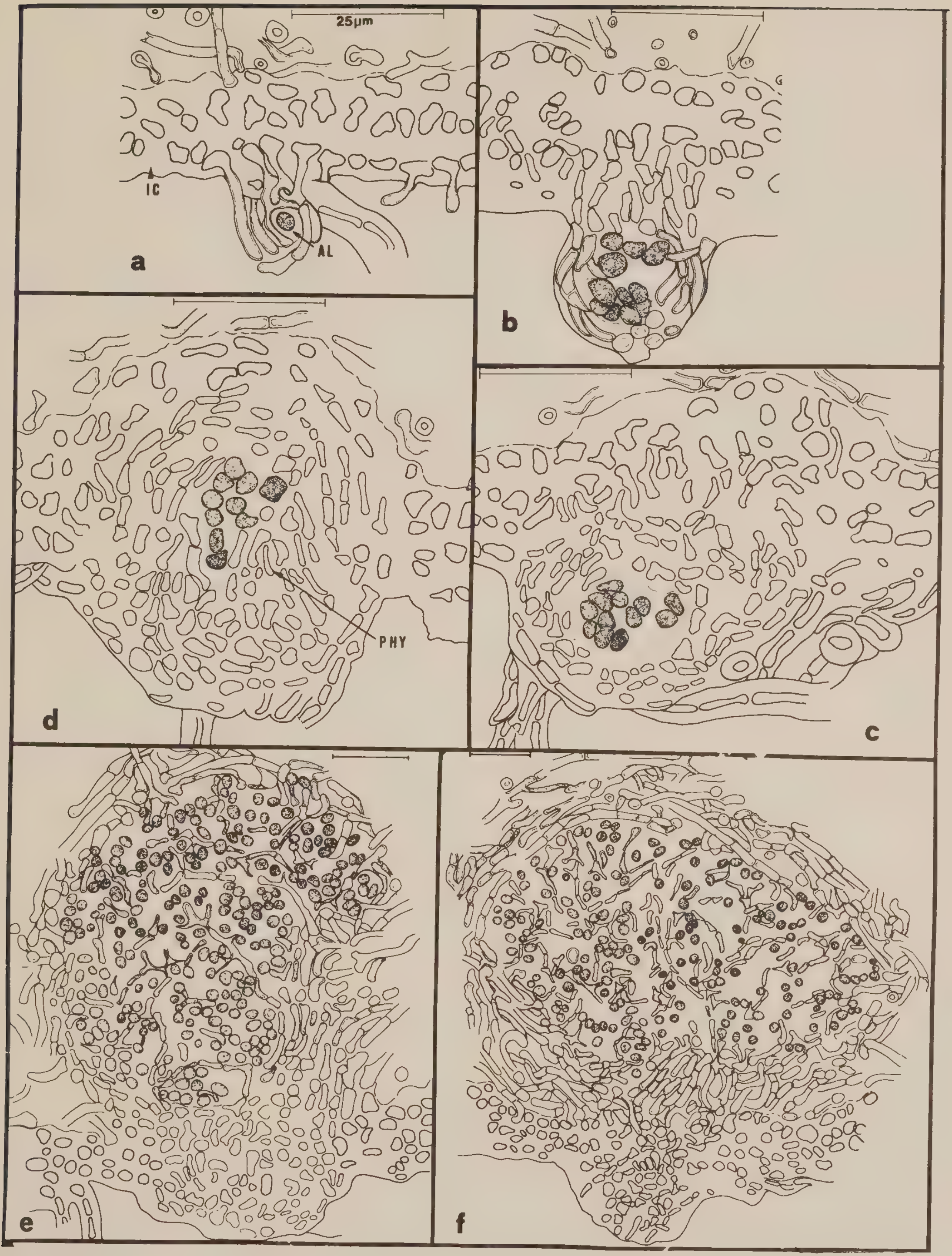
this compound.

DISCUSSION

The similarity shown by pairs of phycosymbiodemes of *Pseudocyphellaria* studied in the developmental processes leading to the formation of chlorosymbiodemes is very striking. In all cases studied chlorosymbiodemes are secondarily produced by the mycobiont of the cyanosymbiodeme. Leaving aside differences in the organisation of other cyanosymbiodemes as well as different sites of origin, the sequence of morphogenetic steps in chlorosymbiodeme development is much the same in *Pseudocyphellaria*, *Sticta* (e.g. "*S.dufourii/S.canariensis*") and *Peltigera* (unnamed (*P.avenosa* Gyelnik)[P.W. James, pers.comm.]blue-green morphodeme with *Coccomyxa*-containing lobes). Whenever a chlorosymbiodeme is formed it is of secondary origin and is characterised by an heteromerous arrangement of tissues. A schematic representation of this process is given in fig. 11, with the chlorosymbiodeme showing heteromerous arrangement of tissues.

Changes in morphology and anatomy in both thalli of joined species resulting from the morphogenetic influences of two different algae vary in their expression. Differences in both secondary metabolites, and developmental morphology of structures such as pseudocyphellae and cyphellae (Renner 1980) in most cases are negligible. That both phycosymbiodemes may produce fruiting bodies (as in an unnamed pair of phycosymbiodemes from *Sticta* - Renner 1980) contrasts with assertions

figure 8: Semi-schematic outline of internal cephalodium-development in *Sticta latifrons* (taken from Renner 1980); The course of development starts with the capture of *Nostoc*-algae (Al) by fungal hyphae of the lower cortex (lc), stage a, followed by successive surrounding of algal cells by hyphae, stage b and c, and the invagination of algal cells into the thallus medulla by hyphal pressure (PHY), stage d, to form an internal cephalodium which then enlarges within the medulla, stage e,f, is typical for foliose green-algal lichens in the Peltigerineae.


25µm
IC
AL
a
b
PHY
d
c
e
f

that sexual reproduction might be influenced by the algae present (James and Henssen 1976).

In the Peltigerineae many chlorosymbiodemes known to occur as independent green-algal lichens (all chlorosymbiodemes studied here) contain internal cephalodia as sometimes do the chlorosymbiodemes themselves. A comparison between cephalodium development and chlorosymbiodeme formation demonstrates certain parallels. Formation of cephalodia may be regarded as the reverse process to that of chlorosymbiodeme formation, e.g. the secondary lichenisation of blue-green algae (*Nostoc*).

The process - illustrated here for *Sticta latifrons*, according to Renner (1980) - starts with capture and encapsulation of epiphytic blue-green algae (fig. 8a) by hyphae of the mycobiont. Very early stages in this process show a small, nodule-like protuberance on the lower surface of the green phycobiont-containing lichen (or chlorosymbiodeme) resembling in structure primordia seen in the formation of chlorosymbiodemes (fig. 8b,c). Unlike the development of chlorosymbiodemes, further differentiation of cephalodia is characterised by an invagination of *Nostoc*-algae into the thallus medulla (figs. 8d,e,f) or, in the case of external cephalodia, by a moderate enlargement of the protuberance to form a ± sacculate, corticate hump with cells of *Nostoc* irregularly distributed throughout the mycobiont tissue (see Henssen and Jahns 1973). In no case is a new heteromerous thallus formed.

In cephalodia the lichenisation of a secondary alga results in a marked change in metabolite pattern. The same situation obtains in *Pseudocyphellaria* and in *Lobaria* (*Lobaria amplissima*, Renner 1980, 1982a,b) and will probably also be true for other members of the Peltigerineae. The change noted is an absence of secondary metabolites from the core of the cephalodia. The absence of these substances may be explained by the diversion of products of primary metabolism (nitrogen fixation) of the alga to the mycobiont where they are absorbed, and probably subsequently fixed and interconverted (Feige 1976, Renner 1980). These latter

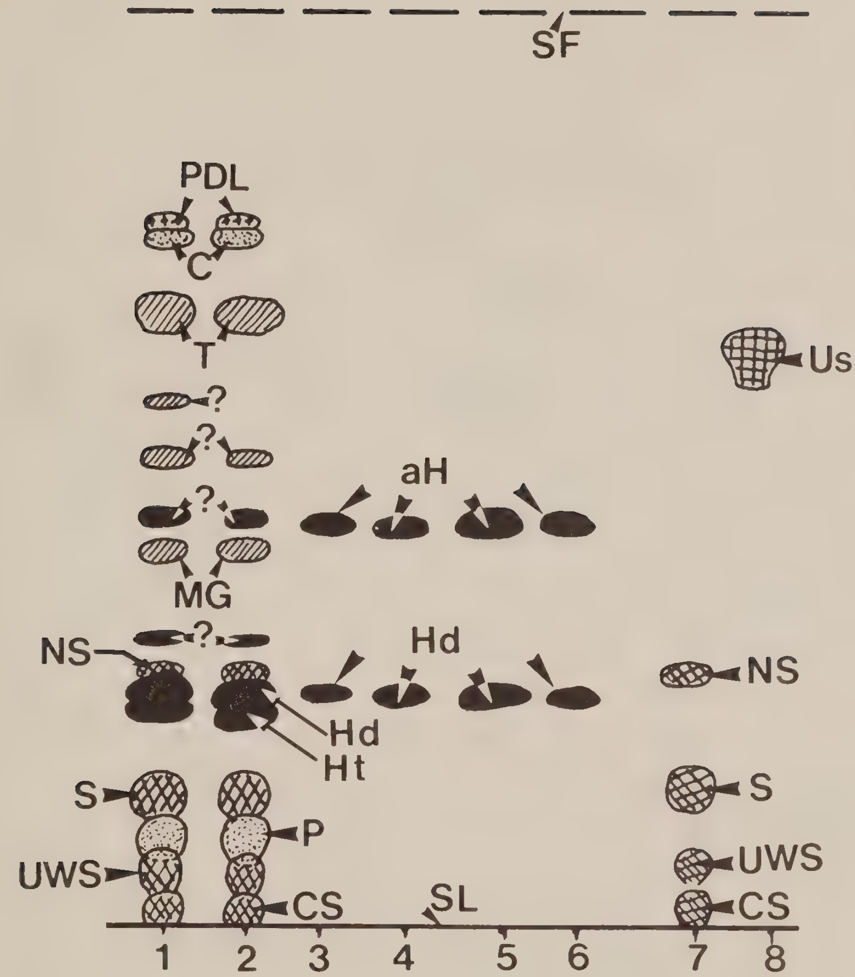


figure 9: Thin layer chromatogram (solvent system C acc. to Culberson 1972) of crude lichen extracts of all pairs of phycosymbiodemes investigated here; position 1: "*P. margaretae*"; position 2: "*P.pubescens*"; Position 3:"*P. murrayii*"; position 4:"*P.rufovirescens*"; position 5: "*P.allanii*"; position 6:"*P.coriacea*"; position 7: stictic-acid-complex standard; position 8: usnic-acid standard; SF: solvent front; SL: start line; PDL: pulvinic dilactone; C: calycin; P: pulvinic acid; T: tenuiorin; MG: methyl gyrophorate; aH:7β-acetoxyhopane-22-ol; NS: norstictic acid; Hd: hopane-15α-22-diol; Ht: hopane-6α-7β-22-triol; UWS: (Unknown S-2 with Stictic acid sens. Culberson 1972) identical with cryptostictic acid; CS: constictic acid; S: stictic acid; Us: usnic acid.

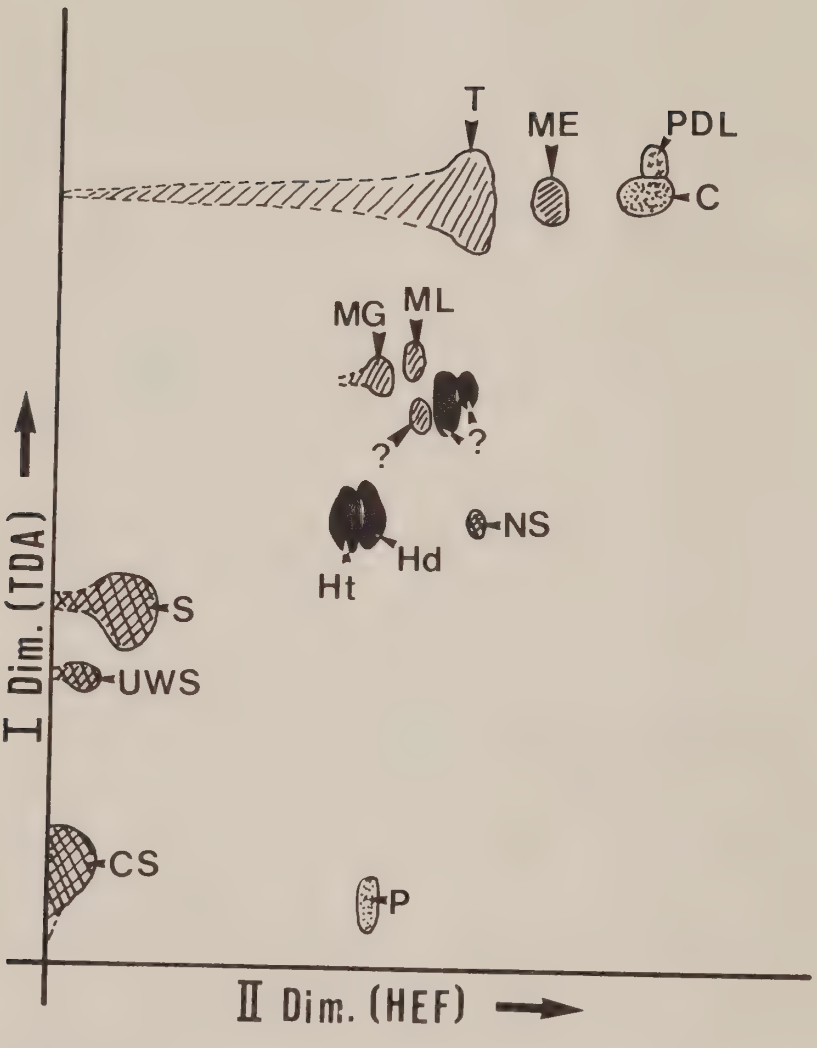


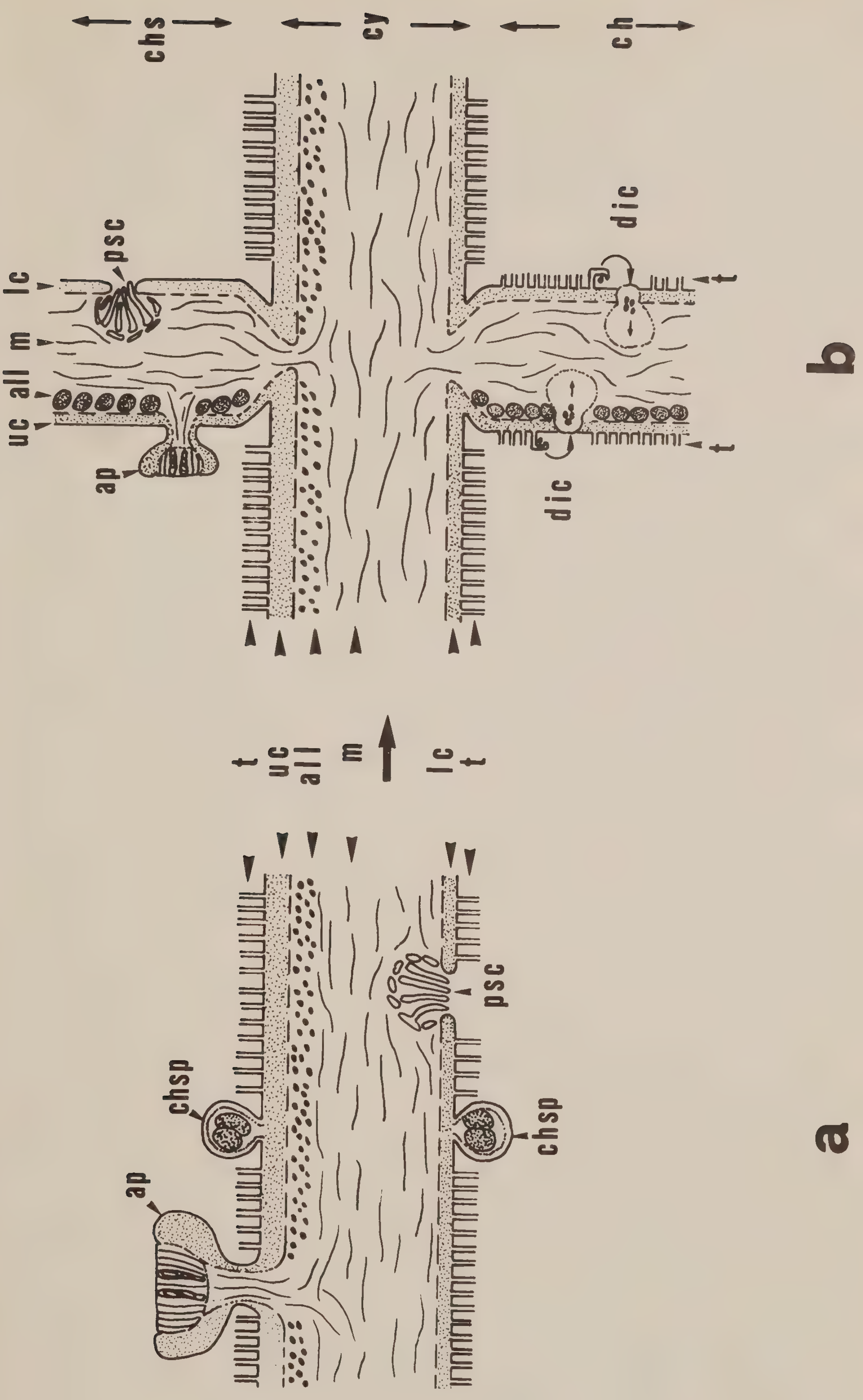
figure 10: Two-dimensional thin layer chromatogram (solvent system A: 1.dimension, B: 2. dimension, A,B acc.to Culberson (1972)) of the acetone extracts of "*P.margaretae*"; ML: methyl lecanorate; ME: methyl evernate; all other abreviations as in fig.9

processes remain to be conclusively proved. Leaving aside the vexed problems involved in demonstrating the presence of lichen substances in different parts of the thallus, the question remains to what extent secondary metabolites may correlate with the alga present. Any discussion of this question must necessarily at present be speculative. As long as we have no reliable evidence for any correlative links between the phycobiont's metabolic activities and the production of lichen substances within the mycobiont we are far from understanding the possible directing role of phycobionts in the expression of phytochemistry in lichen symbioses. The absence or the additional presence of some secondary products in either phycosymbiodeme may well be known but cannot be determined by considering the algae alone. The converse case, viz., taking the identity of secondary products in both phycosymbiodemes as proof of the continuity of the mycobiont in joined thalli (Jordan 1972) is also inadmissable. The only metabolites known at present to be clearly confined to the mycobiont are the methylamines (Bernard et al. 1974, 1980), however these products are of restricted occurence. James and Henssen (1976) record that *Sticta dufourii* has a distinct fishy smell (methylamines) whereas *S. canariensis* does not have any smell at all. Contrasting with this assertion one of us was able to prove by gas chromatography (Renner 1980) that free-living specimens of either species mentioned above do contain trimethylamine. The proportion in the two species could not be determined. Evidence for divergent metabolic activities in the tissues of lichenised mycobionts comes from an *in-situ* localisation of lichen acids using a cytophotometric technique (Renner 1982a,b). It is shown in this study that in contrast to high concentrations of depsides and depsidones in the medulla, no substances of this class were detectable within the fungus tissue of cephalodia in green-algal species of *Pseudocyphellaria*, *Lobaria* and *Nephroma*. Further, the detection in some species of *Pseudocyphellaria* of sustantial concentrations of secondary products in particular thalline structures (e.g. pseudocyphellae and soralia: in "*P.margaretae/P:pubescens*" the yellow pseudocyphellae contain pulvinic acid and its derivatives) or in the medulla, supports the assumption of a heterogenous metabolic activity of the lichenized mycobiont. These facts cannot at present be satisfactorily explained.

The reflections outlined here have some important implications for interpretations based on secon-

dary metabolites detected in both phycosymbiodemes or in structures of the green-algal thallus containing blue-green algae, e.g. cephalodia. Whereas in the inner mycobiont tissues of some external cephalodia such as in *Nephroma kuehnemanii* , no metabolites are detectable, the cortex of the cephalodia may give a positive result for at least some secondary metabolites characteristic of *N.kuehnemanii* (Renner 1980, 1982b). Extraction of excised cephalodia of this lichen and analysis of the extract while showing the presence of secondary metabolites, does not prove that the detected compounds are synthesised in the cephalodia under the influence of the secondary algae (*Nostoc*).
The difficulties inherent in correlating secondary metabolites with any particular algae in the symbiotic association will only be resolved by carefull labelling experiments with ^{14}C-labelled precursor substances and such investigations are curently in progress.

figure 11: Schematic outline of phycosymbiodeme formation in *Pseudocyphellaria*; a: blue-green algal lichen; if a tomentum (t) is present on the upper cortex (uc) and on the lower cortex (lc) the capture of green algal cells may occur on both cortices; chsp: chlorosymbiodeme primordium; ap: apothecia; all: algal layer; m: medulla; psc: pseudocyphellae; b: resulting pair of phycosymbiodemes, with lobes of the chlorosymbiodeme (chs) on either surface of the cyanosymbiodeme (cys) at sites of formation of chlorosymbiodeme primordia; above: fertile chlorosymbiodeme with tomentum on both cortices and the development of internal cephalodia (dic); the fully developed chlorosymbiodeme may represent a combination of the two demonstrated alternatives.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chsp
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MYCOTAXON

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A Note on *Sporotrichum gougerotii* Matruchot 1910

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SUMMARY

The taxon *Sporotrichum gougerotii* Matruchot 1910 is rejected as a *nomen dubium* because the name is of uncertain application. Owing to the absence of type material, an inadequate description, and the lack of illustrations, there has been no consistent taxonomic concept for this fungus. We reject as invalid the recently proposed new combinations of *Exophiala gougerotii* Ravisse et Rodriguez Vindas 1981, *E. gougerotii* South, Brass et Stevens 1981, and *E. gougerotii* Nishimura et Miyaji 1982.

INTRODUCTION AND DISCUSSION

In 1907, Beurmann and Gougerot (1) described an atypical case of sporotrichosis (case XI) in a patient suffering from tuberculosis. The infection manifested itself as a painless, deep, hard nodule on the right thigh. Prolonged direct examination of pus aspirated from the nodule revealed a single, oblong fungal form that Beurmann and Gougerot considered to be compatible with that produced by a species of *Sporotrichum* Link. The fungus that was isolated from the aspirated pus was described as being black, slow growing, and producing bouquets of 6 to 12 spores with a few spores being borne singly only in the center of the colony. On the basis of these findings, the authors equated their isolate with *Sp. beurmannii* (as *beurmanni*) Matruchot et Ramond 1905, which is now considered to be a later synonym of *Sporothrix schenckii* Hektoen et Perkins 1900. Unfortunately, Beurmann and Gougerot paid little attention to the alleged tissue form of the fungus, which cast doubt on the very existence of a mycotic infection. On the basis of the data furnished in their case report, one could conclude that the recovered fungus was merely a contaminant.

Beurmann and Gougerot gave their isolate to Matruchot, who in 1910 (13) described it as *Sp. gougerotii* (as *gougeroti*). It is uncertain whether or not Matruchot intended the name *gougerotii* to be used as a variety or species name. On page 545 of his paper (13), he wrote "Je le considère comme une variété stable du *S. Beurmanni* et le dénomme *S. Gougeroti*". Later on that same page, Matruchot stated that among the small group of fungi that caused sporotrichosis, he recognized *Sp. gougerotii* as one of the "...trois types assez différents pour constituer trois espèces distinctes ..." In one instance he proposed *Sp. gougerotii* as a variety of *Sp. beurmannii*, and in a second instance a distinct species. Since Matruchot did not refer to Beurmann and Gougerot's description of the isolate presented to him (1), the name *Sp. gougerotii* must rest solely upon the description that Matruchot provided in his study. Matruchot considered the aerial fructifications produced by *Sp. gougerotii* to be intermediate to those of *S. schenckii* and *Sp. beurmannii*. In addition, Matruchot described a "budding" form as being characteristic of *Sp. gougerotii*. Judging from his description, the "budding" form may have consisted of, in part, toruloid hyphae. The description provided by Matruchot is so vague that it is impossible to determine the diagnostic characteristics of his fungus, which has resulted in substantial taxonomic confusion. Unfortunately, a specimen was not prepared, illustrations were not provided, and the culture that Matruchot had used for the description of *Sp. gougerotii* was not saved. As a result, Matruchot's taxon has been classified in the genera *Rhinocladium* Saccardo et Marchal (22), *Torula* Persoon (12), *Dematium* Persoon (7), *Oospora* Wallroth (10), *Cladosporium* Link (5), *Phialophora* Medlar (2), and *Rhinocladiella* Nannfeldt (19) by various investigators.

Castellani and Chalmers (6) considered *Sp. gougerotii* to differ "....from the typical *Sp. beurmannii* only in small details, the principal ones of which are the black pigmentation of the colonies from the very beginning, and the extremely abundant sporulation." This disposition can be supported by examining the exquisite drawings prepared by Nannizzi (16) for figure 194 in his text book. These show the characteristic sympodial conidiogenous cells and arrangement of conidia that are typical of the genus *Sporothrix* Hektoen et Perkins. In contrast, Grütz (8) and Grigoraki (7) characterized *Sp. gougerotii* as producing what appears to be toruloid hyphae with and without clusters of round cells associated with the hyphae. Some of their illustrations are suggestive of *Moniliella* Stolk et Dakin. Janke's (10) concept parallels that of Grütz, with the additional morphological form of budding yeast cells being included (see his figures 6 and 11). A third interpretation of *Sp. gougerotii* was presented by Kesten et al. (11), Young and Ulrich (23), and Borelli (3), who depicted the conidiogenous cells as being cylindrical and bearing clusters of conidia at their apices as seen in the genus *Exophiala* Carmichael.

In 1953, Young and Ulrich (23) isolated a dematiaceous hyphomycete from a human case of phaeohyphomycosis. They identified it as *Sp. gougerotii* and sent it to Gougerot, who confirmed their identification. Borelli obtained a subculture of Young and Ulrich's (NCMH 575) isolate and in 1955 designated it as the neotype for *Sp. gougerotii* (3). He then transferred the taxon to the genus *Phialophora* (2). Borelli considered *E. jeanselmei* (Langeron) McGinnis et Padhye 1977 and *Wangiella dermatitidis* (Kano) McGinnis 1977 to be later synonyms of *P. gougerotii*. Because a living culture can not serve as a neotype (Article 9.5, ICBN) (21) and a specimen was not provided (4), Borelli's proposed neotype is invalid. In addition, even if his proposed neotype had been prepared properly as stipulated under the rules of nomenclature, his neotype could not be accepted because it can not be shown that the neotype is compatible with the protologue of *Sp. gougerotii* (Article 8.1, ICBN).

The problem of Gougerot's confirmation (23) of Young and Ulrich's isolate as *Sp. gougerotii* needs to be taken under consideration. It is important to remember that the protologue fixes the characteristics of the taxon. NCMH 575 could have been typical of the culture that Gougerot gave to Matruchot, but it may not have been what Matruchot actually described. In addition, Matruchot (13) made no reference in his paper to the description of the fungus that Beurmann and Gougerot provided in their paper (1). If Gougerot and Matruchot had saved their original cultures or specimens, this doubt would not have arisen. Even though Gougerot considered NCMH 575 to be *Sp. gougerotii*, a fungus that he had isolated 46 years earlier, the description provided by Matruchot must be followed. Based upon the descriptions provided by Beurmann and Gougerot and by Matruchot, it is now impossible to determine if these authors were working with the same fungus.

In 1968, Schol-Schwarz (19) proposed the new combination *Rhinocladiella mansonii* (Castellani) Schol-Schwarz. She treated *Sp. gougerotii* as a later synonym of this taxon. Recently, de Hoog (9) considered *Sp. gougerotii* to be a later synonym of *E. mansonii* (Castellani) de Hoog 1977. McGinnis (14) concluded that *Sp. gougerotii* sensu Borelli represents misidentified isolates of *E. jeanselmei* and that *Sp. gougerotii* sensu Matruchot was a later synonym of *S. schenckii.*

In three recent independent studies, the new combination *E. gougerotii* has been invalidly proposed. Ravisse and Rodriguez Vindas (18) in 1981 cited "*Exophiala gougerotii* (*Phialophora gougerotii*), McGinnis et Padhye, 1977" as an etiologic agent of phaeohyphomycosis. Because McGinnis and Padhye (15) did not propose this combination, the name *E. gougerotii* must be attributed to Ravisse and Rodriguez Vindas. This name is invalid and must be rejected because they did not publish it in accordance with Article 33.2 of the ICBN. South, Brass, and Stevens (20) also invalidly proposed the name *E. gougerotii* and incorrectly implied that Zaias (24) had used this name. Nishimura and Miyaji (17) in their studies on *W. dermatitidis* used the binomial *E. gougerotii.* As in the case of Ravisse and Rodriguez Vindas, the latter two proposals must be rejected for the same reason. The invalid name *E. gougerotii* could have been avoided, if these three groups of investigators had followed the provisions of the International Code of Botanical Nomenclature.

In summary, we believe that the name *Sp. gougerotii* should be rejected because the identity of Matruchot's fungus can not be determined with certainty. The name *Sp. gougerotii* is considered to be a *nomen dubium* because its application is uncertain. This taxonomic problem exists because the original cultures and specimens were discarded, illustrations were not provided, and the description of the taxon was inadequate.

ACKNOWLEDGEMENTS

The authors wish to thank Dr. Donald Rogers for reviewing our manuscript.

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PARAFFIN EMBEDDING AND SEMITHIN SECTIONING OF BASIDIOCARP TISSUES

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ABSTRACT

Microscopic details of basidiocarps are important in species determination among agarics. A method of embedding in paraffin was devised to demonstrate sporocarp microscopic morphology. Semithin (3 µm) microtome sections were obtained that clearly revealed the cuticle, context, and tramal region; the hymenium remained indistinct.

INTRODUCTION

Microscopic characters are important to taxonomic studies, especially at, or below, the species level (Singer, 1962; Hesler & Smith, 1979). Agaricologists typically have used hand sectioning to study the microscopic morphology of basidiocarps. Paraffin sectioning should provide more consistent results, but no satisfactory technique has been reported. The technique described here produces material which can be cut to 3 µm thickness. The uniform quality and thinness of the sections make them well suited for photography. As an additional advantage, the permanently prepared slides can be kept for future reference.

MATERIALS AND METHODS

Pieces of the pileus and stipe of fresh basidiocarps were placed in a 70:25:5 (v/v) water, ethanol, formalin fixative (Corner, 1967) for a minimum of 24 h. Portions approximately 4x4 mm were cut from these pieces and dehydrated in an upgraded series of tertiary butal alcohol (TBA) solutions (Johansen, 1940): TBA 1 (2 h), TBA 2 (2 h), TBA 3 (2 h), TBA 4 (2 h), TBA 5 (overnight), and finally absolute TBA (3 changes; 4 h, 4 h, and overnight). Following dehydration, the tissues were infiltrated by three 20-minute changes of molten paraffin (56°-$57^{\circ}C$), and embedded in fresh paraffin. Tissue blocks were sectioned at 5 and 3 μm using a rotary microtome and sections mounted on slides lightly coated with Mayer Albumin Fixative (Humason, 1979). Sections were floated on a thin film of distilled water applied to the edge of the ribbon. The slides were transferred to a 39°C warming tray for 6-12 h, deparaffinized in two changes of xylene (5 and 3 min respectively), and rehydrated by means of a downgraded series of ethanol: 100% and 95% (5 min each); 85%, 70% and 60% (3 min each). The slides were further rehydrated in 3% (w/v) potassium hydroxide (KOH) (5 min), stained in a 1:1 (v/v) aqueous solution of 1% phloxine and 1% Congo Red (30 min), rinsed in distilled water, and again placed in 3% KOH (15 min). Coverslips were mounted using Kaiser Glycerine Jelly (Humason, 1979).

RESULTS

Sections were cut at 5 μm thickness to demonstrate the cuticular layers and at 3 μm to show the trama and context. Satisfactory sections of less than 3 μm in thickness could not be obtained as tissues tended to compress and wrinkle during sectioning.

The 3 μm thick sections clearly demonstrated the pileal and stipe cuticles, context, and lamellar trama (Figs. 1, 2, 3, 4), but morphology of the hymenial elements was indistinct. Despite the lack of structural detail in the hymenium, it was possible to determine the relative density and positioning of the cystidia (Fig. 4).

DISCUSSION

While hand sectioning is a useful method, paraffin embedded tissues yield more consistent results as they can be cut at a uniform thinness.

Berta (1976) described an embedding method using butylmethacrylate and styrene with benzoyl peroxide from which 2 μm thick sections of agaric tissues were obtained. With respect to morphology, the 3 μm thick sections cut from paraffin embedded tissues are comparable to Berta's (op. cit.) results. Plastic embedding techniques involve potentially carcinogenic, costly, and non-reusable materials in contrast to the less toxic, less expensive, and reusable chemicals involved in the paraffin method.

ACKNOWLEDGEMENTS

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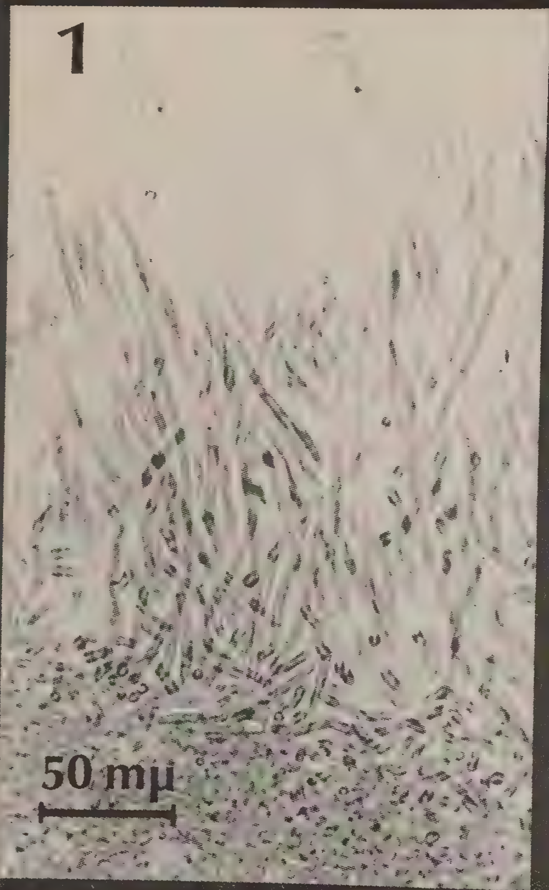
Figures 1-4. 1. Stipe cuticle of *Lactarius vellereus* (section 5 μm thick). 2. Pileal cuticle of *L. volemus* (section 5 μm thick). 3. Context tissues of *L. deceptivus* (section 3 μm thick). 4. Trama and hymenium of *L. volemus* (section 3 μm thick).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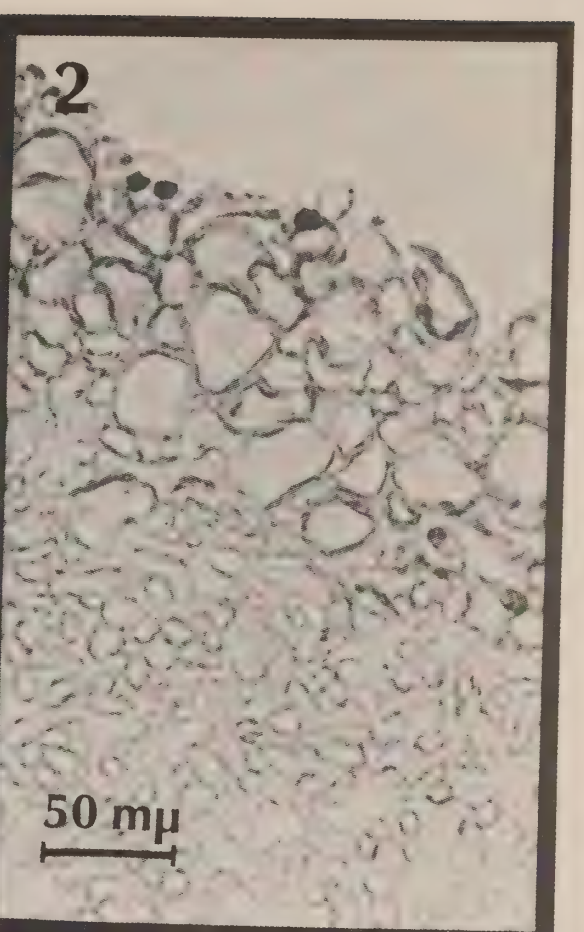
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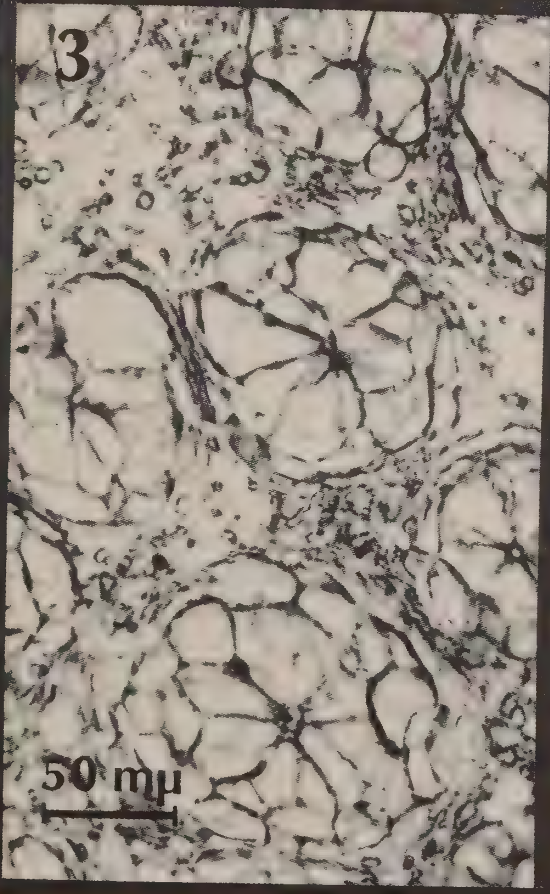
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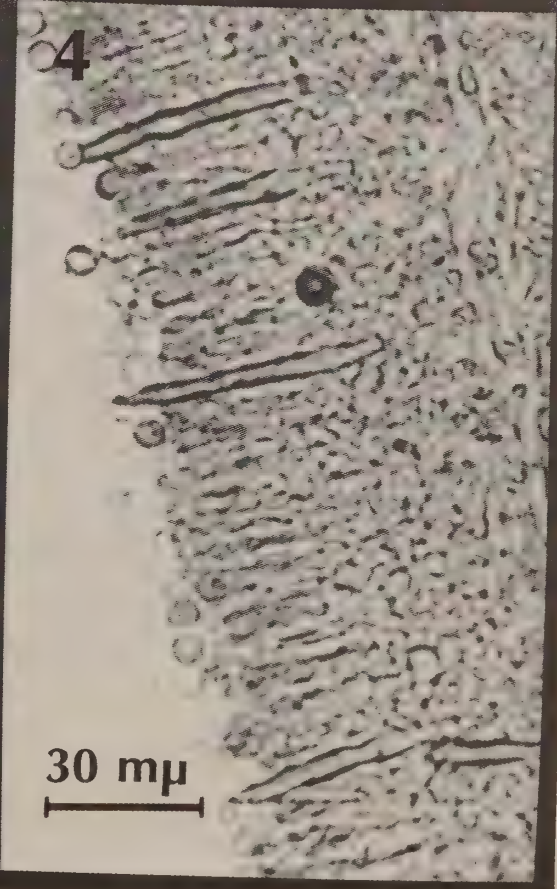
4
30 mμ

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BASIDIOSPORE VARIATION IN LOCAL POPULATIONS OF SOME APHYLLOPHORALES

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The variability of mean spore length, width and spore form index Q (mean length divided by mean width) of eleven local populations of five *Phellinus* spp. and one local population of *Polyporus rhizophilus* was studied. The coefficient of variation, V, for spore length and width usually lay between 2-10, and for Q between 1-8. These values are within the range found for similar parameters in other organisms.

The variability of mean spore length and width is usually smaller, and that of mean Q considerably smaller at the population level than at the individual level.

The variability of Q is much smaller with subglobose spores than with cylindrical ones.

Spore size and spore form are characters widely used in the taxonomy of fungi for distinguishing closely related species. However, these characters have a statistical meaning but are frequently used uncritically without taking into consideration the extent of their variability. In our earlier paper (E. Parmasto & I. Parmasto, 1982) we asserted that the variability of these characters in the Aphyllophorales is complicated and includes several components.

The coefficient of variation (or variability) $V = \frac{\sigma \cdot 100}{\bar{x}}$ has been evaluated by Simpson, Roe & Lewontin (1960) as the most convenient measure of variability. It has been widely used in zoology and botany (including algology) but rarely in mycology and probably not until now for the Aphyllophorales.

This paper deals with the variability of mean spore length, width and spore form index Q (ratio of mean length to mean width) of five *Phellinus* species in 11 local populations. For comparison, the variability of *Polyporus rhizophilus* in one local population was also studied.

MATERIALS AND METHODS

The following species were studied: *Phellinus alni* (Bond.) Parm. *(Ph. igniarius* (Fr.) Quél. f. *alni* Bond.), *Ph. hartigii* (All. & Schn.) Pat., *Ph. hippophaëcola* H. Jahn, *Phellinus igniarius* (Fr.) Quél. s. str., *Ph. robustus* (P. Karst.) Bourd. & Galz., and *Polyporus rhizophilus* Pat.

Spore samples were collected as spore prints shed during 24 hours from basidiocarps under natural conditions, simultaneously from all the basidiocarps in each population studied, except in two cases (*P. rhizophilus* and *Ph. hippophaëcola* from Sweden), where spores of herbarized basidiocarps collected within about one hour were measured.

From every sample 30 spores were measured in 2 % KOH solution using an eyepiece micrometer at a magnification of x 700 under the microscope МБИ-6. For every sample the mean values of spore length, spore width and Q, and the coefficient of variability V_{ind} of these data were calculated. Similar data were thereafter calculated for each population, the coefficient of variation of sample means within a population being denoted V_{pop}. Details of the samplings are given in Table 1.

RESULTS are summarized in Table 2.

DISCUSSION

The number of specimens (samples) in the populations studied was rather small (from 6 to 17) but the results are similar enough to draw some conclusions, and Simpson, Roe & Lewontin (1960) also used some rather small samples (N = 8; 10) among their examples.

Variability of spores in one sample (specimen).

The value of the variation coefficient V was usually 4-10 for spore length and width, and 3-8 for Q in the *Phellinus* species. The mean value of V for Q (4.77) was somewhat smaller than the ones for spore length (6.43) and spore width (6.30); this is obviously connected with the subglobose spore form. The mean value of V for Q was higher in *Polyporus rhizophilus* (10.3), which has cylindrical spores.

Variability of the means of specimens within one population.

The value of V was usually 2-7 for spore length and width, and 1-2.7 for Q in the *Phellinus* species. The mean value of V for Q is much higher in *Polyporus rhizophilus* (5.7), which has cylindrical spores. Compared with the variability of the spores of one basidiocarp, that of individual basidiocarps of the same population is usually somewhat smaller for the mean spore length and width, but always and remarkably smaller for Q.

Extent of variability in the fungi studied.

According to Rokickij (1973), the value of V ranges mostly between 5 and 10 in homogeneous biological material. Simpson, Roe & Lewontin (1960) as well as Mayr (1969) asserted that the great majority of *V*'s for the linear dimensions of the anatomical elements of mammals lie between 4 and 10. Blue algae show similar or a little greater variability (Kondratyeva, 1980). Our data fall within the same range; obviously, the extent of variability of essential meristic characters is similar in most organisms.

Variability between different populations of the same species.

The comparision of data which may seem to be possible for the *Phellinus alni* and *Ph. hippophaëcola* populations has been avoided due to the fact that they were sampled at different times. It has been demonstrated previously (I. Parmasto & E. Parmasto, 1977), that spore size of *Phellinus* species may vary considerably within the same specimens during the sporulation period. Obviously, comparison of different populations in this group of fungi yields reliable results only when the samples (from all populations!) have been collected simultaneously, or in sufficient numbers at quite different times and/or in the case of basidiocarps at different stages of their development. Even simultaneous collection of samples may only yield suitable material when the collecting areas are not too far from each other thus avoiding differences in weather conditions.

Possibility of comparing the spores of two specimens.

Sometimes it is necessary to compare two specimens (usually types) to establish their possible conspecificity. Having measured a sufficient number of spores, it is possible to use Student's *t*-test for establishing the significance of difference between their mean measurements.

To evaluate such comparisions we studied two sets of spore samples from *Ph. igniarius* and *Ph. hippophaëcola* (from Sweden). Both sets were characterized by relatively small variability of spores both of specimen and local population levels.

Using the *t*-test in *Ph. igniarius* all (136) possible combinations (pairs) of specimens were compared and it was established that the difference in the mean spore length was highly significant (at $P < 0.001$) in 26 cases and significant (at $0.001 < P < 0.01$) in 21 cases. Similar results were obtained for *Ph. hippophaëcola:* of 66 possible combinations (pairs) of specimens the difference was highly significant in 20 cases and significant in 10 cases.

These results were obtained using specimens of one local population characterized by a rather small coefficient of variability and collected at the same time. Even in such "ideal" cases the comparision of two randomly selected specimens using the *t*-test does not give any useful information for the establishment of their species identity or difference. A biometrical comparison is only reasonable between two populations, or between a population and a single specimen.

TABLE 1. SAMPLING DETAILS

Species	Sampling Code	Location	Diam. of Sampling Area (km)	Substrata	Date of Sampling	No. Basidiocarps Sampled
Phellinus alni	A	Estonian SSR, Põlva Distr., Valgemetsa	3	Alnus incana Padus racemosa Sorbus aucuparia	11-12.VI.69	8
	B	as above	3	Alnus incana Padus racemosa	14-15.X.69	8
	C	Estonian SSR, Jõgeva Distr., Levala	2.5	various deciduous trees	16-17.IX.70	13
	D	Estonian SSR, Viljandi Distr., Polli	2	Malus domestica	31.VIII.-1.IX.70	6
	E	Polar Urals, Krasnyj Kamen'	1.5	Alnaster fruticosus	7-8.VIII.69	12
Ph. hartigii		Ukrainian SSR, L'vov Reg., Truskavets	2	Abies alba	19-20.IX.69	8
Ph. hippophaëcola	A	Altai Reg., Katun' Basin		Hippophaë rhamnoides	IX.69	9
	B	Dagestan ASSR, Samur Nature Reserve	0.5	Hippophaë rhamnoides	7-8.VI.74	6
	C	Sweden, Uppland, near Billuden	0.4	Hippophaë rhamnoides	30.VIII.74	12
Ph. igniarius		Byelorussian SSR, Byelovezhskaya Pushcha Nature Reserve	3	Quercus petraea	24-25.IX.69	17
Ph. robustus		as above	3	Quercus robur	24-25.IX.69	10
Polyporus rhizophilus		Tajik SSR, Ramit Nature Reserve	0.015		11.IV.77	11

TABLE 2. DIMENSIONS (μm) OF SPORES OF LOCAL POPULATIONS OF APHYLLOPHORALES

Species	Sampling Code	Spores of Individual Basidiocarps Range of Means			Population Means			V_{ind}						V_{pop}		
								Length		Width		Q				
		Length	Width	Q	Length	Width	Q	Range	Mean	Range	Mean	Range	Mean	Length	Width	Q
Phellinus alni	A	5.57-6.75	5.10-6.30	1.07-1.13	6.12	5.59	1.11	4.9-6.8	5.6	4.4-7.5	5.6	3.2-6.5	4.6	6.3	6.9	1.8
	B	5.79-7.07	5.23-6.41	1.08-1.14	6.32	5.66	1.12	4.8-9.6	6.9	6.0-11.5	7.4	4.6-10.1	6.5	7.3	7.1	2.7
	C	5.12-5.99	4.60-5.51	1.06-1.11	5.68	5.18	1.10	4.4-7.9	6.2	3.6-7.1	5.4	3.4-6.9	4.7	4.1	4.7	1.9
	D	5.69-5.96	5.04-5.35	1.10-1.13	5.78	5.20	1.12	5.3-9.0	6.8	4.9-7.4	6.0	3.9-6.6	5.2	1.7	2.0	0.9
	E	5.66-6.61	5.12-6.04	1.08-1.13	6.01	5.43	1.11	4.1-6.8	5.4	4.5-7.2	5.9	3.6-5.5	4.4	3.9	4.2	1.5
Ph. hartigii		8.18-9.71	7.55-9.10	1.04-1.10	8.76	8.16	1.08	4.3-9.3	6.8	3.8-8.2	6.1	2.7-5.9	4.2	6.0	5.6	1.8
Ph. hippophaëcola	A	7.12-7.28	6.36-6.61	1.09-1.12	7.19	6.53	1.10							0.9	1.4	1.0
	B	5.71-6.88	5.21-6.03	1.07-1.13	6.40	5.79	1.11	4.4-7.2	5.7	4.2-8.0	6.0	3.8-7.3	4.7	6.2	5.2	2.1
	C	5.89-6.72	5.48-6.22	1.06-1.08	6.29	5.87	1.07	4.2-8.8	7.0	4.4-9.3	7.2	2.1-4.7	2.8	4.0	3.9	0.6
Ph. igniarius		5.58-6.20	4.98-5.46	1.08-1.16	5.80	5.28	1.11	5.5-9.4	6.8	4.9-10.0	6.7	4.7-8.3	5.9	3.2	2.8	2.2
Ph. robustus		7.12-8.38	6.74-7.59	1.06-1.13	7.66	7.06	1.08	5.6-9.7	6.9	2.5-12.9	6.4	3.6-7.7	4.7	5.0	3.7	2.3
Polyporus rhizophilus		7.54-8.73	3.40-3.77	2.09-2.49	8.20	3.57	2.32	8.1-11.8	9.6	8.7-20.6	11.9	7.9-12.5	10.3	5.7	2.7	5.7

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NEW SPECIES OF FUNGI FROM THE YUCATAN PENINSULA * **

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SUMMARY

Eight new species of fungi from the Yucatan Peninsula (Mexico) are described. These are HYPHOMYCETES: *Rhinotrichum mexicanum*; AGARICALES: *Lepista singeri*, *Melanoleuca tropicalis*, *Amanita silvatica*, *A. yucatanensis*. *A. dunicola* and *Inocybe tropicalis*, and HYMENOGASTRALES: *Octavianina ciqroensis*. All of them are from the tropical rain forests, except *Amanita dunicola* which grows in the dunes in the north of the peninsula where it is associated with *Coccoloba uvifera*.

INTRODUCTION

During an extensive mycological exploration in the tropical rain forests of Quintana Roo, and parts of Yucatan and Campeche States, in November 1981, the author, in collaboration with the Biologist Armando Lopez from Xalapa, Ver., found numerous interesting fungi, lichens, and Myxomycetes, many of them newly recorded in Mexico, of which eight species are described here. Other (Lepiotaceae fungi) in Guzmán Dávalos and Guzmán (1982).

All herbarium material is deposited in the following three herbaria Mexican Institutes: Escuela Nacional de Ciencias Biológicas (ENCB) Mexico City, Instituto Nacional de Investigación sobre Recursos Bióticos (INIREB), Xalapa, Veracruz and Centro de Investigaciones de Quintana Roo (CIQRO), Puerto Morelos, Quintana Roo. The latter has been provisionally deposited in Merida, Yucatan .

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The microscopic study was made from section mounted in KOH (5%) or Melzer's solution. The colors of the spore, hyphae and cystidia are described from mounts in KOH solution.

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HYPHOMYCETES

Rhinotrichum mexicanum Guzmán, sp. nov. Figs. 1-3

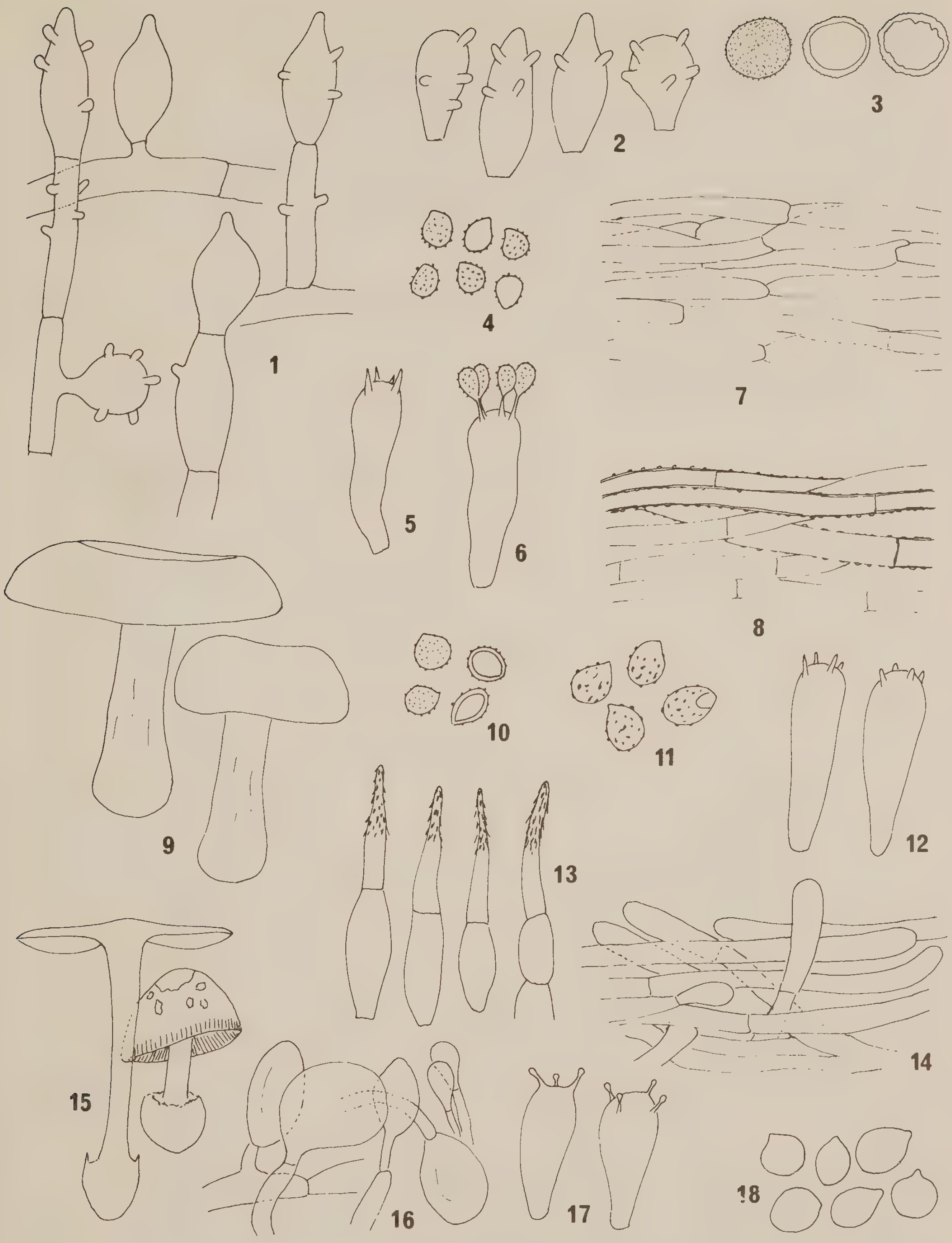
Mycelium flocci caespitosi, septati, brunneus ferrugineus, hyphae pallide brunneae 6-12 um latae. Conidiophoris 11-25 X 7-9 um, globosis vel ventricosis dein clavatus. Sterigmatis numerosus breviculus. Conidiis 10-13 um latae, globosis, hyalinae, tenuis verrucosis. Ad ligna vel corticem, subsilva tropicalis. Quintana Roo prope, Coba-Nueva Xcan, López 1922 (Typus ENCB).

Mycelium ferrugineus brown, cottony, forming a loose cushion-like mass on the substratum. Hyphae pale brown, septate, intricately interwoven, 6-12 µm diam. Fertile branches erec or suberect. Conidiophores globose to ventricose or clavate, sometimes mucronate; with numerous short sterigmata over the surface, 11-25 X 7-9 µm; sterigmata not more than 3 µm long. Frequently the spores are borne on numerous sterigmata on cells below of the conidiophore. Spores hyaline, globose, thick walled, finely rough, 10-13 µm diam.

Habitat. On bark in an open (disturbed) tropical rain forest.

Specimens examined. MEXICO, QUINTANA ROO, Coba to Nueva Xcan road, near the crossing to Sajaca-chen, López 1922 (Type, ENCB).

Discussion. This fungus is close to R. subalutaceum Peck, from NE of United States, but that species has spores 8-10 µm diam., conidiophores which are not globose and mycelium that is



Figs. 1-18.- 1-3: *Rhinotrichum mexicanum*, 1: Hyphae and conidiophores, 2: Conidiophores, 3: Spores.- 4-9: *Lepista singeri*, 4: Spores, 5: Basidium, 7: Trama, 8: Structure of the pileus, 9: Carpophores.- 10-14: *Melanoleuca tropicalis*, 10: Spores in KOH, 11: Spores in Melzer solution, 12: Basidia, 13: Cheilocystidia, 14: Structure of the pileus.- 15-18: *Amanita silvatica*, 15: Carpophores, 16: Elements of the volva on the pileus, 17: Basidia, 18: Spores.

yellowish brown. It is also close to R. subferruginosum Sumstine in the color of the mycelium and tropical habitat (Jamaica forests), but that species has smooth spores (Sumstine, 1911). It is probable that R. mexicanum has a wide distribution throughout the tropical forests of Mexico (the author has observed this kind mycelium on bark in forests in Veracruz State). Balfour-Browne (1952) described R. domesticum Balfour-Browne and R. lanosum (Cooke) Cooke as growing on walls in England, both with smooth spores.

AGARICALES

Tricholomataceae

Lepista singeri Guzmán, sp. nov. Figs. 4-9

Pileo 50-80 mm lato, convexo vel applanato dein subdepresso, levi, haud hygrophano, brunneolo griseus vel brunneolo alutaceus. Lamellae subdecurrentibus vel subadnatis, subroseus. Stipite 45-55 X 10-15 mm, centralis vel subcentralis, albidus. Carne alba, inmutabili, odore et sapore gratus vel fortis aromaticus. Sporis 5.4-7 X 3.5-4.5 μm, hyalinae, globosis or ellipsoides, subtiliter echinatis, haud amyloideis. Haud cystideis. Hyphis fibuligeris. Quintana Roo, Puerto Morelos Prope, silva tropicalis, Guzmán 21010 (Typus, ENCB).

Pileus 50-80 mm diam., convex to plane or subconcave or subinfundibuliform, smooth, sometimes with radical fibrills or subrimose, dry, brownish gray or brownish leather color, with some metalic shine, non hygrophanous. Lamellae subdecurrent or subadnate, pale rose, more or less distant. Stipe 45-55 X 10-15 mm, central or excentric, equal or slightly tapering, bulbous, whitish, fibrillose, smooth but somewhat floccose above, solid to somewhat hollow, subcartilagineus, with white short rhizomorphs. Context white; taste and odor pleasant; dried specimens with strong aromatic odor. KOH stains the pileus reddish brown.

Spores 5.4-7 X 3.5-4.5 μm, hyaline, globose or ellipsoid, thin walled, finely echinulate, inamyloid. Basidia 28-37 X 8-9μm, tetrasporic, hyaline, ventricose-fusoid. Pleurocystidia and cheilocystidia absent. Trama regular, with hyaline hyphae 4.5-11 (-15)μm diam., thin walled, with numerous clamp connections. Pileus surface with appressed hyaline hyphae, 3-6μm diam., some with irregular incrusted brown pigment.

Habitat. Solitary or gregarious on humus, in the tropical rain forests, below several species of trees, e.g., Achras zapota (as ectomycorrhizic ?).

Specimens examined. MEXICO, QUINTANA ROO, near the road from Puerto Morelos to Tulum, close to the crossing to Vallarta, footpath to the sea, Guzmán 21010 (Type ENCB); Guzmán

21018; Guzmán 21032; López 1875. 10 km. from Tomas Garrido, km 77 on road from Chetumal to Escarcega, Guzmán 20883.

Discussion. This species is close to *L. glabella* (Speg.) Sing. known from Argentina, Paraguay, Brazil and Florida in subtropical forests, but differs in the absence of an aqueous zone in the gills close to the stipe, as well as in the presence of a brown aqueous zone in the context above the gills, in the absence of an odor and in the size of the spores (4.8-6.2 × 3.3-4.2 µm), according Singer & Digilio (1951). None of the species of *Lepista* described by Pegler (1977) from Africa agree with *L. singeri*. This is first record of a *Lepista* in the tropical rain forests of Mexico. The specimen 21018 was identified tentatively as *L. singeri* because it is a young carpophore without spores, and with the pileus surface formed from hyaline to somewhat incrusted more or less repent hyphae 3-6um diam. The context has the same odor and the KOH also stains the pileus brown reddish.

Melanoleuca tropicalis Guzmán, sp. nov. Figs.10-14

Pileo 15-35 mm lato, convexo vel subapplanato, glabro, brunneolus griseus vel griseus plumbeus. Lamellis subadnatis, albidis vel pallide cremeis. Stipite 20-40 × 1-2 mm, haud bubose, albido, glabro. Carne albidae, odore nullo. Sporis (5.2-) 6-7.5 × 4.5-6 (-6.7) µm, globosis vel ellipsoideis, verrucosis, fortiter amyloideis. Pleurocystidiis analogus cheilocystidiis, rarus. Cheilocystidiis 31.5-55.5 × 4.5-9 µm, numerosus, obclavatis vel lanceolatis, hyalinis, parte centralis septatis, ad apicem acutissimis, crystallis hyalinis ad apicem incrustatis. Haud fibulis. Ad terram in silva tropicalis. Quintana Roo, Puerto Morelos Prope, Santa Matilde, Guzmán 21430 (Typus ENCB).

Pileus 15-35 mm diam., convex to somwthat plane or subconcave, glabrous, dry grayish brown to grayish lead color. Lamellae subadnate, white or whitish to pale yellowish. Stipe 20-40 × 1-2 mm equal, white to whitish, glabrous. Context whitish, odorless.

Spores (5.2-) 6-7.5 × 4.5-6 (-6.7) µm, globose or subellipsoid, hyaline, verrucose, thin walled, strongly amyloid, with a more or less distinct plage on one side close to the apiculus. Basidia 16.5-28.5 × 9-10.5 µm, hyaline, tetrasporic ventricose. Pleurocystidia scarce, like the cheilocystidia but without apical crystals. Cheilocystidia 31.5-55.5 × 4.5-9 µm, numerous, obclavate or lanceolate, with a transver septum in the middle part and with characteristic hyaline apical crystals. Trama of more or less interwoven hyaline hyphae. Pileus surface with appressed or subappressed hyphae, with brownish gray content, 3-9 µm diam. Clamp connections absent.

Habitat. Solitary on humus in the tropical rain forests.

Specimens examined. MEXICO, QUINTANA ROO, Puerto Morelos to Vallarta road, 1 km. from the crossing to Tulum, Santa Matilde, Guzmán 21430 (Type ENCB). Puerto Morelos to Tulum, close to the crossing to Vallarta, footpath to the sea, Guzmán 21079.

Discussion. This species is close to M. brevipes (Bull. ex Fr.) Pat. because of the cheilocystidia, but differs in the size of the spores (8-10.5 X 4.5-6µm sensu Pegler, 1977; 7-8.5 X 4.5-6 µm sensu Bon et al., 1973) and in the long stipe (short in M. brevipes). It is also close to M. pseudoluscina Bon but that species has spores (6-) 7-8.5 (-9.5) X (5-) 6-7.5 (-8) µm (Bon, 1980). M. tropicalis is also close to M. tucumanensis Sing. from Argentina (Singer & Digilio, 1951), but differs in the size of the spores (7.5-10.3 X 6.2-7.5um) and in the basidia (31-35 X 8-9.7 µm). Previous to this report, Melanoleuca was only known in Mexico in temperate forests (Mendiola, 1974).

AMANITACEAE

Amanita silvatica Guzmán, sp. nov. Figs. 15-19

Pileo 20-35 mm lato, convexo dein applanate, subviscidus, centro umbonatus, margin sulcatus striatus, aurantio luteus, margin albidus, fragmentum volvae tenuis, luteus, forma irregulariter. Lamellae liberae, albae. Stipite 35-45 X 3-7 mm, albus, exannulatus. Volva subsacciformis, alba, friabilis, marginis aurantio luteus et fimbriate. Carne alba. Sporis (4.9-) 6.7-9 (-9.7) X (4.9-) 6-7.5 (-8.2) µm, globosis vel subglobose, haud amyloideis. Celluis volva 18.7-49.5 X 7.5-30 µm, globosis, fusiformis vel subellipsoideis. Fragmenta volva celluis pileo (9-) 25.5-43.5 (-45) X (6-)16.5-26.2(-30) µm, globosis vel subellipsoideis et subfusiformis. Fibule absentes. Ad terram in silva tropicalis. Quintana Roo, Puerto Morelos prope, López 1847 (Typus, ENCB).

Pileus 20-35 mm diam., convex to plane, smooth to sulcate-striate at the margin, subviscid, yellowish orange to pale yellow toward the margin, glabrous or with scattered, irregularly shaped, yellowish, rather thick, floccose-membranous flat patches from the volva. Lamellae free, white to cream. Stipe 35-45 X 3-7 mm, equal or attenuated upward, base globose or subglobose, white to whitish cream, somewhat floccose below. Annulus absent. Volva as an adhering sac, with the upper part free, with the margin fimbriated or lacerated, white to orange yellowish on the margin. Context white, odor not distinctive.

Spores (4.9-)6.7-9(-9.7) × (4.9-)6-7.5(-8.2) µm, globose to subglobose, with a short apiculus, hyaline, inamyloid. Basidia 19.5-22.5 × 9-9.7 µm, tetrasporic, hyaline, ventricose. Cells of the margin of the volva 18.7-49.5 × 7.5-30 µm, globose, fusiform or subellipsoid, hyaline, thin walled, borne on hyphae 1.5-13.5 µm broad. Cells of the volva on the pileus globose, subfusiform or subellipsoid, (9-)25.5-43.5(-45) × (6-)16.5-26.2(-30) µm, hyaline, thin walled, borne on hyphae 3-12 um broad. Clamp connections absent.

Habitat. Subgregarious on soil in a tropical rain forest (as ectomycorrhizic ?).

Specimens examined. MEXICO, QUINTANA ROO, near the road from Puerto Morelos to Tulum, close to the crossing to Vallarta, footpath to the sea, López 1847 (Type, ENCB).

Discussion. A. silvatica is close to A. elata (Mass.) Corner & Bas, which is known only from Singapore and differs in the size of the cells of the volva at the stipe (40-60 × 25-40 µm), presence of annulus, in the difference in the color of the pileus (pale dingy ochraceous buff or dingy buff with sulphur yellow tones) and in the more narrow volva at the bulb without fimbriate edges (Corner & Bas, 1962).

Amanita yucatanensis Guzmán, sp. nov. Figs. 20-23

Pileo circa 25 mm lato, convexo dein subapplanato, margin sulcatus, siccus, albus vel subflavidus, fragmentum volvae albidus, tenuis, forma irregulariter. Lamellae subliberae, albae. Stipite circa 12 × 5 mm, albus, squamosus, exannulatus. Volva sacciformis, alba, tenera. Sporis (7.5-)9-12(-12.7) × (7.1-)8.2-9 (-10.5) µm, globosis, haud amyloideis. Celluis volva subglobosis, 30-52.5 × 12-21 µm, hyalinae. Fibule absentes. Ad terram in silva tropicalis. Quintana Roo, Puerto Morelos prope, Guzmán 21044 (Typus, ENCB).

Pileus about 25 mm diam., convex to somewhat plane, smooth to striate at the margin, dry, white to pale yellowish, glabrous or with some scattered irregularly shaped, whitish, thin, flat patches of the volva. Lamellae subfree, white to whitish rose, with fimbriate edges. Stipe about 12 × 5 mm, very attenuated upward, floccose-scaly to pruinose above, without annulus. Volva more or less high and wide, as a membranous sac, white and delicate. Flesh white, odorless.

Spores (7.5-)9-12(-12.7) × (7.1-)8.2-9(-10.5) µm, globose with a short apiculus, hyaline, inamyloid. Basidia 42-54 × 10.5-13.5 µm, tetrasporic, but some mono or bisporic, hyaline, ventricose, with a middle constriction. Cystidia none. Trama with elongated to broad cells, hyaline. Volva with subglobose hyaline cells, 30-52.5 × 12-21µm, borne on narrow hyphae 2.2-9 µm broad, many of them with grayish irregularly incrusted pigment on the walls. Epicutis formed by more or less repent hyaline hyphae, 3-7.5 µm broad. Hypodermium with subglobose hyaline elements, 9-19.5 µm broad. Clamp connections absent.

Habitat. Solitary on soil in a tropical rain forest.

Specimens examined. MEXICO, QUINTANA ROO, Road to Vallarta, near the crossing from Puerto Morelos to Tulum road, Guzmán 21044 (Type, ENCB).

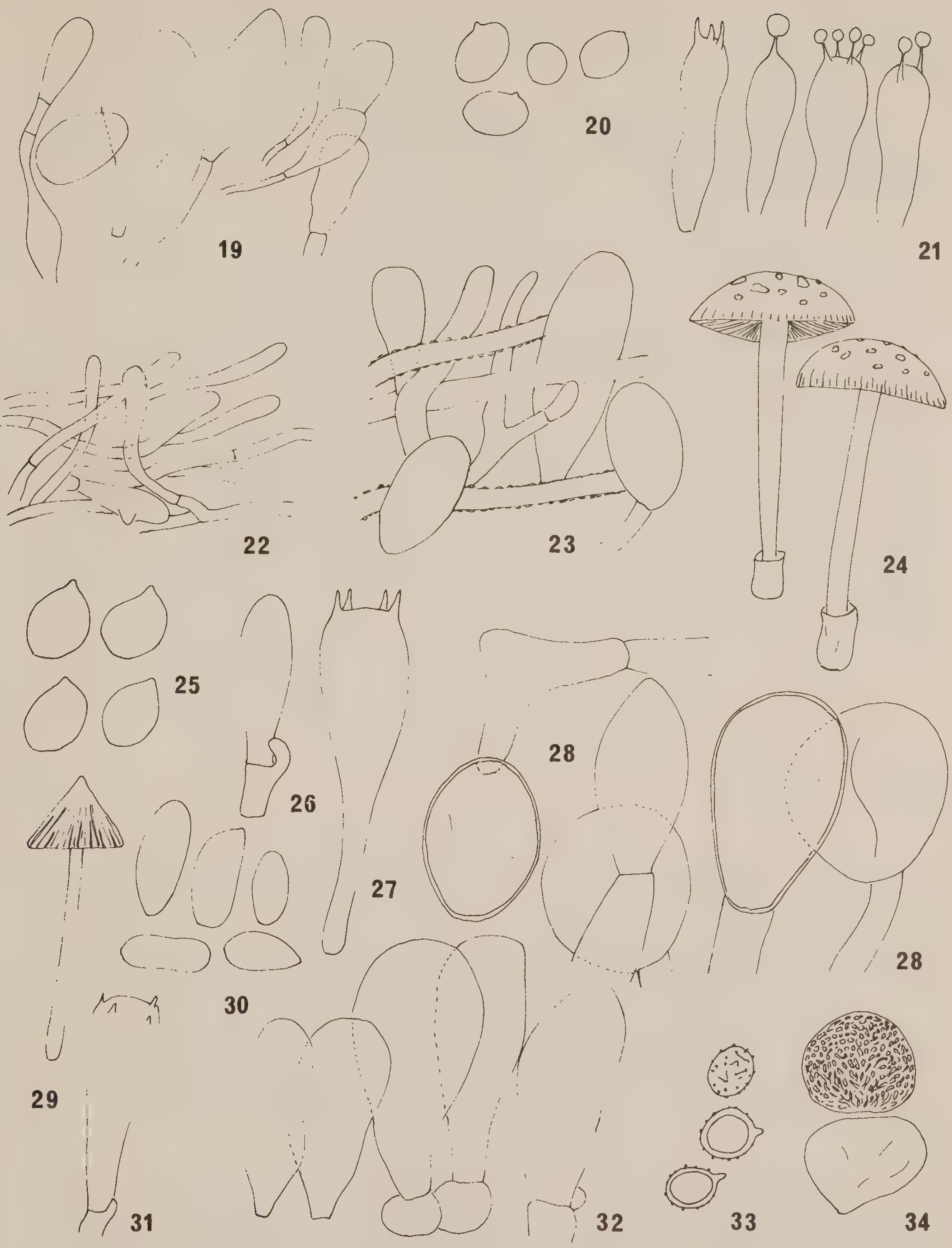
Discussion. This species is very close to _Amanita_ species No. 4 of Corner & Bas (1962), known only from Singapore, but differs in the spores (9-11.5 × 7-8.7 µm). The white basidiocarp seems similar to _A. praegraveolens_ (Murr.) Sing., also a tropical species, but that fungus has scaly floccose, poorly formed volva and amyloid spores (Guzmán 1975).

Amanita dunicola Guzmán, sp. nov. Figs. 24-28

Pileo 15-40 mm lato, convexo dein subcampanulatus vel subapplanato, subviscidus, sulcatus-striatus, subbrunneolus vel alutaceous, fragmentum volva albus tenuis, forma irregulariter. Lamellis liberae, albidus roseus. Stipite 30-80 × 3-7 mm, albus vel inaequaliter brunneolus, exannulatus. Volva sacciformis, alba, tenera. Sporis (9.9-)11-12.5(-13.5) × 8-9 µm, subglobosis, non amyloideis. Celluis volva globosis 17-38 µm. Fibule in the basidia. Ad arena contiguus ad oceanus. Yucatan prope, circa Ixil, Progreso-Telchac, Guzmán 21235 (Typus, ENCB).

Pileus 15-40 mm diam., convex to subcampanulate or somewhat plane, smooth to sulcate-striate at the margin, subviscid, pale brownish to leather brown, with white, irregularly flat patches from the volva. Lamellae free, whitish rose to rose brown, with white fimbriate edges. Stipe 30-80 × 3-7 mm, equal or somewhat attenuate at the base, smooth but floccose under the lens, white to irregularly brownish. Annulus absent. Volva as a membranous sac, white and delicate, more or less permanent in the adult. Context white, odor not distinctive (but in dry specimens very pleasant, like bread); taste pleasant.

Spores (9.9-)11-12.5(-13.5) × 8-9µm, subglobose with a short apiculus, hyaline, inamyloid. Basidia 50-70 × 13-16 um, tetrasporic, hyaline, clavate; sterigmata up to 6µm long. Cystidia absent. Trama with hyaline elongated hyphae, 3-6 µm broad, some anastomoses. Cuticle of the pileus subgelatinous, formed by hyaline to brownish appressed hyphae up to 5 µm



Figs. 19-34.- 19: *Amanita silvatica,* elements of the volva on the stipe.- 20-23: *Amanita yucatanensis,* 20: Spores, 21: Basidia, 22: Structure of the pileus, 23: Elements of the volva.- 24-28: *Amanita dunicola,* 24: Carpophores, 25: Spores, 26: Young basidium with a clamp connection, 27: Basidium, 28: Elements of the volva at the stipe.- 29-32: *Inocybe tropicalis,* 29: Carpohore, 30: Spores, 31: Basidium, 32: Cheilocystidia.- 33-34: *Octavianina cigroensis,* 33: Spores, 34: Carpophores.

broad. Elements of the volva globose, hyaline, 17-38μm broad, thin to thick walled, borne on hyphae 3.3-6μm broad. Clamp connections observed only at the base of the basidia.

Habitat. Gregarious, rarely solitary, in sand below Coccoloba uvifera, in dunes close to the sea. It seems to be an ectomycorrhizic fungus.

Specimens examined. MEXICO, YUCATAN, Municipio de Ixil, Progreso to Telchac road, Guzmán 21235 (Type, ENCB).

Discussion. This species is close to A. antillana Dennis from Trinidad, but differs in the friable volva, in the scaly-floccose stipe, broader spores (7.5-11.5μm), glabrous and olive brown or grayish pileus, and in the habitat (ad terram in silvis) (Dennis, 1952, 1970). It is also close to Amanitopsis floridana Murr. from Florida, because of color of its pileus and non friable volva, but it has narrower (6-7 μ m) spores and grows on soil close to pines (Murrill, 1949). Amanita species No. 5 of Corner & Bas (1962) from Singapore is also close, but differs in its glabrous pileus and broader spores (9.5-11 μ m).

CORTINARIACEAE

Inocybe tropicalis Guzmán, sp. nov. Figs. 29-32

Pileo 20-25 mm lato, conic, bruneus aurantius, vel brunneolus, fortiter rimosus. Lamellis brunneus aurantiacus cum albidus fimbriate marginis. Stipite 16-18 × 3-5 mm, albidus vel rufobrunneus. Carne albidus, odor nullus. Sporis (8.8-) 12-13(-17.6) × 5.5-6.6(-7.7)μm, subellipsoideis vel oblongatus-ellipsoideis. Plecrocystidiis absens. Cheilocystidiis 44-55 × 12-27.5μm, hyalinea, subclavate vel subturbinate, sine crustare. Epicutis cum parallelis vel suberigo hyphae, 7-15 (-20) μm latus. Hyphae fibululigeris. Ad terram, solitario, in silva tropicalis. Quintana Roo, Tomas Garrido prope, Guzmán 20927 (Typus, ENCB).

Pileus 20-25 mm diam., conic, brownish orange to pale brown, strongly radially fibrillose and rimose, revealing the pale context. Lamellae subadnate, brownish orange with white fimbriate edges. Stipe 16-18 × 3-5 mm, uniform, whitish to yellowish, finally brownish red, smooth, somewhat cortinate in the middle portion. Context whitish, odorless.

Spores (8.8-)12-13(-17.6) × 5.5-6.6(-7.7) μm, subellipsoid or oblong-elliptical, brownish mustard, with a narrow germ pore. Basidia 35-40 × 11-15μm, tetrasporic, hyaline, ventricose-clavate, with sterigmata up to 2um thick. Pleurocystidia absent. Cheilocystidia 44-55 × 12-27.5 μm, numerous, hyaline, subclavate or subturbinate, without incrustations. Subhymenium pale brownish mustard. Trama regular, hyaline. Pileus surface with prostrated to somewhat erect incrusted brownish orange pigmented hyphae, 7-15(-20)μm broad. Clamp connections observed in several hyphae, even at the base of basidia and cheilocystidia.

Habitat. Solitary on soil in tropical rain forest (ectomycorrhizic ?).

Specimens examined. Mexico, Quintana Roo, 10 km N of Tomas Garrido (South of Quintana Roo), Guzmán 20927 (Type ENCB).

Discussion. *I. tropicalis* is somewhat close to *I. jalapensis* (Murr.) Sing. but differs in the presence of pleurocystidia (55-80 × 16-20 μm) in that species as well as in the size of the spores (7.7-9.8 × 4.2-5.7μm), and in the subtropical distribution. Murrill described that species from Xalapa, Ver. and Dennis reported it from Colombia (Singer, 1957; Dennis, 1970), in both cases it is ectomycorrhizic and associated with *Quercus*. It is also close to *I. jamaicensis* Murr. but that species has rugose spores 8-9 × 5μm (Murrill, 1912). The only species of *Inocybe* reported by Pegler (1977) from Africa is *I. lanuginella* (Schroet.) Konr. & Maubl. from a *Pinus* forest in Tanzania, which has pleurocystidia.

HYMENOGASTRALES

Octavianina ciqroensis Guzmán, sp. nov. Figs. 33-34

Carpophoris 5-10 mm lato, globosis vel subglobosis. Peridio luteus vel spadiceus. Gleba albidus vel spadiceus. Sporis (8.2-)9-12(-13.5) × (7.5-)9-9.7(-10.5)μm, globosis, pseudoamyloideis, verrucosis subreticulatis. Cystidiis nullis. Hypogaeum in silva tropicalis. Quintana Roo prope, Carrillo Puerto-Vijia Chico, López 1759 (Typus, ENCB).

Gastrocarp globose or subglobose, 5-10 mm diam. Peridium glabrous, with some innate veins especially below, thin, yellow, fading to leather brown. Gleba chambered, whitish to pale brownish, columella and sterile base absent.

Spores (8.2-)9-12(-13.5) ×(7.5-)9-9.7(-10.5) μm, globose, hyaline, verrucose, subreticulate, pseudoamyloid, with a short but conspicuous appendage. Cystidia none. Peridium with irregularly elongated hyaline to pale brownish hyphae, without clamp connections.

Habitat. Hypogeous in humus of a tropical rain forest.

Specimens examined. MEXICO, QUINTANA ROO, 20 kms from Felipe Carrillo Puerto, road to Vijia Chico, López 1759 (Type, ENCB).

Discussion. O. tuberculata (Hesse) O. Kuntze and O. laevis (Hesse) O. Kuntze are the only species somewhat close to O. ciqroensis following Singer & Smith (1960) key's, but they differ in diameter and ornamentation (broad cones) of the spores (12-16 µm diam. in the first, and 13-18(-20) µm diam. in the second). Both species are only known from Germany. Apparently O. ciqroensis is the first record of the genus in the tropics, at least in Mexico.

The name of the species refers to CIQRO Institution (Centro de Investigaciones de Quintana Roo) in recognition to the support given to this research project through its Director, Dr. Alfredo Carreaga.

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TWO NEW FAMILIES IN THE ASCOMYCOTINA

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SUMMARY

Two new families are described in the Ascomycotina for the first time. Ascodichaenaceae fam. nov. (Rhytismatales) is introduced for Ascodichaena, Delpinoina, and (?) Pseudophacidium. Odontotremataceae fam. nov. (Ostropales) is described for Bryodiscus, Lethariicola, Odontotrema, Odontura, Skyttea, Spilomela, Stromatothecia and Xerotrema.

In the course of our investigations on the systematics of the Ascomycotina, it became clear that two groups of these fungi were worthy of recognition in the rank of family. These two family names are formally described here and their circumscription and affinities discussed.

ASCODICHAENACEAE D.Hawksw. & Sherw. fam. nov.

Familia ad ordo Rhytismatales pertinens. Ascomata stromatica, erumpescentia, aggregata, carbonacea, disciformia ad breve hysteriformia, longitudinaliter apperientia, excipulum vero desunt, stromata ex cellulis pseudoparenchymatis polyedricis et verticalis. Paraphyses numerosae, simplices, septatae. Asci cylindrici sed clavati ubi maturitati, tenue, cum apicibus late annulatis, probaliter operculati, 4-8-spori. Ascosporae hyalinae, simplices.

Anamorphosis holoblasticae vel ignota.

Holotypus: Ascodichaena Butin.

Family belonging to the order Rhytismatales (syn. Phacidiales auct.). Stromata erumpent in dense clusters, carbonaceous, true excipulum absent, stromatal tissue orbicular to short-hysteriiform, opening by a longitudinal slit, composed of vertically orientated polyhedral pseudoparenchyma. Paraphyses numerous, simple, septate. Asci at first cylindrical and sessile, becoming clavate or saccate as the ascospores mature, thin-walled, I-, with a broad apical annulus, possibly operculate, 4-8 spored. Ascospores large, colourless, unicellular, lacking a gelatinous sheath.

Anamorph coelomycetous, holoblastic (Polymorphum Chev.), or unknown; spermatial phase sometimes present.

Habitat: On the bark of Fagaceae in temperate regions of the Northern Hemisphere.

Genera: *Ascodichaena* Butin, *Delpinoina* Kuntze (syn. *Henriquesia* Pass. & Thüm.) and possibly *Pseudophacidium* P. Karsten.

Relationships: Butin (1977) summarized earlier treatments of *Ascodichaena*, concluding that it was most closely allied to *Pseudophacidium* and referring it to the family Phacidiaceae Fr. However, neither *Ascodichaena* nor *Pseudophacidium* have an ascus with an amyloid apical ring such as that seen in *Phacidium* Fr. This distinction, and the presence of a holoblastic anamorph in *Ascodichaena* and a phialidic one in *Phacidium*, indicates that the former is most appropriately placed in the Rhytismatales. Further, the distinctive anamorph, the stroma, and absence of sheaths on the ascospores, justifies the placement of *Ascodichaena* in a separate family within that order.

The family name Dichaenaceae Fr. cannot be taken up for this family as the type species of *Dichaena* Fr. is anamorphic (Hawksworth & Punithalingam, 1973). Speer (1980) considered that *Dichaena* was a teleomorphic generic name but his conclusions were based on a number of misinterpretations of the Code which will be discussed by DLH in a separate paper.

On the basis of ascus structure, the Phacidiaceae is most appropriately referred to the Helotiales and has strong affinities with the Dermateaceae Fr. In addition to *Phacidium*, the Phacidiaceae comprises *Lophophacidium* Lagerberg, *Phacidiostroma* Höhnel, and perhaps also the genera *Cryptomycina* Höhnel, *Nannfeldtia* Petrak, *Micraspis* Darker and *Phacidina* Höhnel.

ODONTOTREMATACEAE D.Hawksw. & Sherw. fam. nov.

Familia ad ordo Ostropales pertinens. Ascomata hemiangiocarpia, apothecia, immersa vel erumpescentia, marginata, singularia vel in stromatis aggregata; excipulum ex hyphis compositum, usque atrobrunnea ad nigra, interdum carbonacea. Asci unitunicati, cylindrici, cum apicibus crassis, plusminusve pori, cum iodo non reagens, 8- vel multispori. Ascosporae ovoideae, sigmoideae, vel filiformiae, hyalinae, septatae ad muriformiae.

Anamorphosis ignota.

Holotypus: *Odontotrema* Nyl.

Family belonging to the order Ostropales. Ascomata hemiangiocarpic, apothecioid, immersed or erumpent, determinate, marginate, single or immersed in a stroma; excipulum hyphal, usually dark coloured and in some genera carbonaceous. Paraphyses simple or branched at the base, septate. Asci cylindrical, sessile or nearly so, the lateral walls thin and the apex thickened, I-, with or without an apical pore, inoperculate, 8- or multispored. Ascospores ovoid, sigmoid, or filiform, hyaline, simple, transversely septate or muriform.

Anamorph not definitely known (a pycnidial fungus was illustrated by Grummann, 1969, associated with *Lethariicola* apothecia but its connection with them is uncertain).

Habitat: Saprobic, chiefly on wood in xeric situations, or lichenicolous (and then usually parasymbiotic).

Genera: *Bryodiscus* Hein et al., *Lethariicola* Grumm., *Odontotrema* Nyl., *Odontura* Clem., *Skyttea* Sherw. et al., *Spilomela* (Sacc.)Keissl., *Stromatothecia* D.Hawksw. & D.Shaw, and *Xerotrema* Sherw. & Coppins. It is also probable that the lichen-forming genera *Bryophagus* Nitschke ex Arnold and *Ramonia* Stizenb. should be referred to this family.

Relationships: This distinctive assemblage of genera was noted by Sherwood et al. (1981) to almost certainly form a natural unit. No new family name was introduced at that time as the application of some other names, especially Triblidiaceae Rehm, was then uncertain. The latter family includes *Pseudographis* Nyl. and *Triblidium* Rebent., *Tryblidiopsis* P. Karsten being more appropriately placed in the order Rhytismatales. The Triblidiaceae differs from the Odontotremataceae in that the covering stroma splits stellately or by a slit to expose the hymenium, the presence of a distinct epithecium, and ascospores which are either transversely septate with lenticular cells or muriform, turning reddish-purple in iodine. This last reaction may indicate some relationship to the Graphidales. The asci in the Triblidiaceae have a strongly thickened apex which can be clearly seen to be pierced by a pore; they are I- as is the case in the Odontotremataceae and Graphidaceae.

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CYLINDROCLADIUM SPATHIPHYLLI SP. NOV.[1]

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ABSTRACT

Cylindrocladium spathiphylli is described as a new species from Spathiphyllum sp. 'Clevelandii' in Florida.

INTRODUCTION

Beginning in late 1978 and continuing to the present, several nurseries in Florida have incurred serious economic losses from a Cylindrocladium root and foliar disease of various species of Spathiphyllum. We have heretofore designated the pathogen as Cylindrocladium floridanum Sobers and Seymour (1967) in previous publications (Schoulties and El-Gholl, 1980a, 1980b, 1981). However, the isolate described from Spathiphyllum is now known to be different from other described species of Cylindrocladium. The following presents the distinctive morphological features of the fungal isolate from Spathiphyllum and provides the basis for establishing it as a new taxon.

METHODS AND MATERIALS

The isolate of Cylindrocladium under study was obtained from basal portions of petioles and from roots of Spathiphyllum sp. 'Clevelandii' which was being grown at a commercial nursery in Apopka, Florida. The isolate of C. floridanum was obtained for comparative study from leaf spots on leatherleaf fern, Rumohra adiantiformis (G. Forst.) Ching which was being grown in Pierson, Florida.

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[1] Contribution No. 256, Bureau of Plant Pathology.

Potato dextrose agar (PDA) was prepared from the broth of 200 g freshly peeled, diced, and boiled Irish potatoes supplemented with 20 g dextrose, 1 g KH_2PO_4 and 18 g Difco bacto-agar, and made up to 1 liter with deionized water.

Peanut stem water agar (PSWA) was prepared in the following manner: cooled (48 C), autoclaved (121 C for 15 min) water agar was poured over dried, propylene oxide-fumigated (Hansen and Synder, 1947) stem pieces of peanut. Under careful handling, the stem piece floated and became partially submerged upon solidification of the agar.

To obtain monoconidial cultures, the method described by Hansen and Smith (1932) was used.

Cultures of Cylindrocladium were grown at 25 C under 12-hour periods of alternating light (fluorescent light, Westinghouse F20T12/CW at an intensity of approximately 2800 lux) and dark on either PDA or PSWA for 10 days.

Morphological features were detailed and measured under oil immersion and were photographed (Fig. 1) with Nomarski differential interference-contrast microscopy using a Zeiss photomicroscope III. Spore measurements represent 400 conidia.

TAXONOMY

The Cylindrocladium from Spathiphyllum sp. 'Clevelandii' differs from other species of Cylindrocladium in the following characteristics. It has 1-septate conidia and a stipe terminating in a globose vesicle, differing from Cylindrocladium ilicicola (Hawley) Boedijn and Reitsma (1950), C. crotalariae (Loos) Bell & Sobers (1966), and C. citri (Fawcett & Klotz) Boedijn and Reitsma (1950) which have globose vesicles and 3-septate conidia. It differs from other species of Cylindrocladium with globose vesicles and 1-septate conidia in having cylindrical conidia 45.0-101.0 x 5.0-7.0 µm as compared to 40-46 x 3-4 µm for the curved conidia of C. curvatum Boedijn and Reitsma (1950) and 30-56 x 3.5-5.4

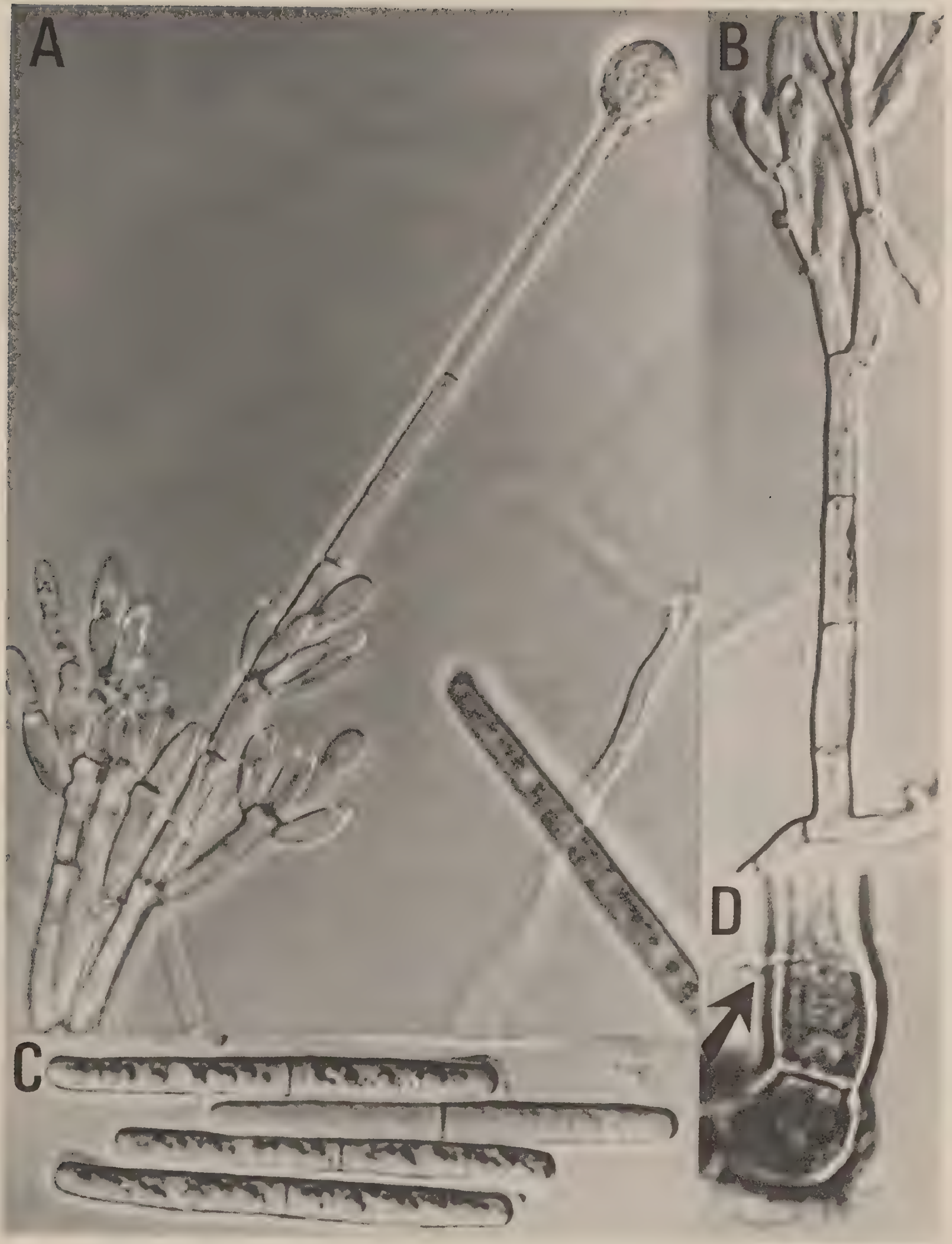

Fig. 1. Cylindrocladium spathiphylli: A) Single central stipe terminating in a globose vesicle, 560 X. B) Conidiophore arising from young procumbent mycelial cell, 560 X. C) One-septate conidia, 560 X. D) Conidiophore arising from a sclerotial cell with a ruptured cellular membrane (collarette - noted by arrow), 1400 X.

µm for the cylindrical conidia of *C. floridanum* Sobers & Seymour (1967). We obtained the following conidial measurements on an isolate of *C. floridanum* from leatherleaf fern: (39.5-) 47.2 (-56.0) µm long by (3.0-) 3.9 (-4.0) µm wide. Further, *C. floridanum* is known to have in addition to the central stipe (an extension of the main axis of the conidiophore stalk) lateral stipes from secondary and tertiary conidiophore branches (Morrison and French, 1969), terminating in sphaeropedunculate (Snell and Dick, 1971) vesicles with a somewhat flattened top, whereas the *Cylindrocladium* from *Spathiphyllum* has but a single, central stipe per conidiophore, terminating in a larger globose, nonsphaeropedunculate vesicle, as well as having larger and wider conidia. Descriptions were based on a monoconidial isolate and were compared with original descriptions of *Cylindrocladium* species. Matings among various isolates from *Spathiphyllum* never produced the teleomorphic state under the conditions studied, hence the species appears to be heterothallic.

On the basis of the differences noted as outlined in Table 1, this isolate is considered morphologically distinct from previously described species in this genus and we propose the following new species:

Cylindrocladium spathiphylli Schoulties, El-Gholl et Alfieri, sp. nov.

Aerium mycelium coloniae in agaro *Solani tuberosi*, bene maturum, initio album et gossypinum, aetate varie brunneum vel rufum. Conidiophora lateraliter portata stipite suragente ex cellulis mycelii procumbentis vel ex cellulis sclerotiorum quae cellulae membranum cellulare ruptum, ut collare parvulum, ad basim stipitis praebent. Conidiophorum ramificatio dichotoma. Rami primarii hyalini, leves, non septati, aliquando uniseptati, (19.0-) 32.8 (-57.0) µm x (4.0) 5.1 (-6.5) µm; rami secundarii vel metulae hyalini, leves, non septati, (13.0-) 21.6 (-35.0) µm x (4.0-) 4.6 (-6.0) µm; rami tertii, cum adsunt, hyalini, leves, non septati (18.0-) 20.3 (-22.0) µm x 4.0 µm. Phialides 2-4, cylindratae, fine apicis obtusae, vel aliquando doliiformes vel reniformes, hyalinae, non septatae, (10.0-) 14.6 (-20.0) µm x (3.0-) 4.2 (-5.0) µm. Stipites vel ex hospite vel ex myceliis in cutura procumbentibus vel ex corporibus sclerotiorum in hospite et in cultura recte surgentes,

Table 1. Comparison of distinctive morphological features of *Cylindrocladium spathiphylli* with *Cylindrocladiun floridanum* that also has one septate conidia.

SPECIES	CONIDIAL MEASUREMENTS LENGTH (μm)	WIDTH (μm)	VESICLE SHAPE	LATERAL STIPES	SEXUAL STATE
C. spathiphylli	(45.0-)80.3(-101.0)	(5.0-)6.0(-7.0)	globose	absent	not known
C. floridanum					
conifer isolate[a]	(33.0-)NG[b](-59.0)	(4.0-)NG(-5.3)	sphaero-pedunculate	present	known
leatherleaf fern isolate	(39.5-)47.2(-56.0)	(3.0-)3.9(-4.0)	sphaero-pedunculate	present	known
peach isolate[c]	(34.0-)NG(-55.0)	(3.5-)NG(-4.8)	sphaero-pedunculate	present	known
Robinia pseudo-acacia L. isolate[d]	(29.0-)41.0(-51.0)	(3.0-)4.0(-5.0)	sphaero-pedunculate	present	known

[a] Morrison and French (1969).

[b] NG = Not given (i.e., average).

[c] Sobers and Seymour (1967).

[d] Terashita (1968) and Sobers (1972).

septati, ad basim dilute brunnei, (7.0-) 7.8 (-9.0) µm lati, (111.0-) 140.8 (-253.0) µm longi, ad apicem sensum hyalini et angustiores (3.0-3.7 µm lati), vesicula hyalina, granulari, globosa, (9.0-) 12.5 (-15.0) µm diam. terminati. Conidia ex apice phialidum singulatim ficta et in circulis vallo similibus et substantia mucilaginosa contentis cumulata, hyalina, granularia, cylindrata, levia, recta, utrisque finibus rotundata, uniseptata, (45.0-) 80.3 (-101.0) µm longa, (5.0-) 6.0 (-7.0) µm lata.

Segregatum ex partibus basalibus petiolarum et ex radicibus Spathiphylli sp. 'Clevelandii' in Apopka, Florida. Depositum ut ATCC 44730 in American Type Culture Collection, 12301 Parklawn Drive, Rockville, Maryland 20852, U.S.A.

Cylindrocladium spathiphylli Schoulties, El-Gholl & Alfieri, sp. nov.

Aerial mycelium of colony on potato dextrose agar, well developed, initially white and cottony, becoming variously brown to reddish brown with age. Conidiophores are borne laterally on a stipe arising from cells of procumbent mycelium or from cells of sclerotia that produce a ruptured cellular membrane seen as a collarette at the base of the stipe. Conidiophore branching is dichotomous. Primary branches hyaline, smooth, nonseptate, occasionally 1-septate, (19.0-) 32.8 (-57.0) µm x (4.0-) 5.1 (-6.5) µm; secondary branches or metulae, hyaline, smooth, nonseptate, (13.0-) 21.6 (-35.0) µm x (4.0-) 4.6 (-6.0) µm; tertiary branches when present, hyaline, smooth, nonseptate (18.0-) 20.3 (-22.0) µm x 4.0 µm. Phialides 2-4, cylindrical with obtuse apical end to occasionally doliiform or reniform, hyaline, nonseptate, (10.0-) 14.6 (-20.0) µm x (3.0-) 4.2 (-5.0) µm. Stipes arise at right angles from the host or from procumbent mycelia in culture or from sclerotial bodies on the host and in culture, septate, light brown at the base (7.0-) 7.8 (-9.0) µm wide, (111.0-) 140.8 (-253.0) µm long, becoming hyaline and narrower at the apex (3.0-3.7 µm wide), terminating in a hyaline, granular, globose vesicle (9.0-) 12.5 (-15.0) µm diam. Conidia are formed singly from the apex of the phialides and accumulate in palisade-like clusters held together by a mucilaginous substance. They are hyaline, granular, cylindric, smooth, straight, rounded at both ends, 1-

septate (45.0-) 80.3 (-101.0) μm long by (5.0-) 6.0 (-7.0) μm wide.

Isolated from basal portions of petioles and from roots of *Spathiphyllum* sp. 'Clevelandii' in Apopka, Florida. Deposited in the American Type Culture Collection, 12301 Parklawn Drive, Rockville, Maryland 20852, U.S.A. as ATCC 44730.

DISCUSSION

Cylindrocladium spathiphylli is closely related to *C. floridanum* but can be separated from the latter because the conidia of *C. spathiphylli* are longer and wider, the vesicle shape is globose (sphaeropedunculate in *C. floridanum*), and lateral stipes are absent (present in *C. floridanum*). Further, the teleomorphic state of *C. spathiphylli* is wanting, whereas that of *C. floridanum* is *Calonectria kyotensis* Terashita (1968). It should also be noted that other isolates of *C. spathiphylli* obtained from various locations in Florida were identical to the described type culture, which clearly represents a distinct species.

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ERYNIA NEOPYRALIDARUM SP. NOV. AND *CONIDIOBOLUS APICULATUS*, PATHOGENS OF PYRALID MOTHS COMPONENTS OF THE MISDESCRIBED SPECIES, *ENTOMOPHTHORA PYRALIDARUM* [ZYGOMYCETES: ENTOMOPHTHORALES]

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ABSTRACT

A reexamination of the species *Entomophthora pyralidarum* Petch showed that the original description was based on different species, namely *Conidiobolus apiculatus* (Thaxter) Remaudière & Keller and another species described here as *Erynia neopyralidarum* sp. nov. The name *E. pyralidarum* should, therefore, be considered as a junior synonym of *C. apiculatus*.

Entomophthora apiculata (Thaxter) Gustafsson, the previous synonym of *C. apiculatus*, included *Entomophthora pseudococci* (Speare) [now *Conidiobolus pseudococci* (Speare) Tyrrell & MacLeod] as a synonym. *C. pseudococci* was subsequently restored as an independent species because of production of microconidia. The restoration of this species is further supported in the present study by evidence of other differences between *C. apiculatus* and *C. pseudococci* in conidial and rhizoidal morphology.

Entomophthora destruens Weiser & Batko, a pathogen of mosquitoes, has rhizoids of the same type as *C. pseudococci*, as well as other familial and generic conidioboloid characters. A new combination, *Conidiobolus destruens*, is proposed for this species.

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INTRODUCTION

Several species of Entomophthorales discovered by T. Petch, including *Entomophthora pyralidarum* Petch, apparently were not encountered again, judging by their very infrequent subsequent citation in the literature. This fungus was described (Petch, 1937) from dead "grass moths" (Lepidoptera: Pyralidae) found in December 1923 and January 1924 in three localities in Ceylon (Sri-Lanka). Specimens had been sent for identification to Prof. R. Thaxter who stated (fide Petch, 1937) that he was not acquainted with the fungus.

The description of *E. pyralidarum* by Petch (1937) was rather sketchy and was not accompanied by photographs or drawings. Characters of taxonomic importance at the generic level, such as the number of conidial nuclei and structure of the conidial wall, were not mentioned. For these reasons *E. pyralidarum* was not included in the classification proposed by Batko (1964-1974, cited from Ben-Ze'ev and Kenneth 1982a) or in the neobatkoan classification of Humber and Ben-Ze'ev (1981). Probably for the same reasons it was not mentioned in the neobatkoan classifications of Remaudière and Hennebert (1980), and Remaudière and Keller (1980). Ben-Ze'ev and Kenneth (1982a) placed *E. pyralidarum* in a newly proposed group, *Entomophthora nomina provisoria*, a group designed for species of Entomophthorales that are incompletely described.

An examination and eventual complementary description of *E. pyralidarum* appeared to be possible because most fungi described and/or collected by Petch and Thaxter were carefully preserved.

E. pyralidarum as depicted by Petch (1937) was an "anomalous" species. It possessed branched conidiophores and rhizoids, features which are very frequently associated in the genus *Erynia* Nowakowski *emend*. Humber and Ben-Ze'ev (1981), and pyriform, oval or globose conidia which are usually characteristic of other genera of Entomophthorales. Globose primary conidia, however, have not been encountered yet in any of the 47 species classified as *Erynia* by Nowakowski (1881), Remaudière and Hennebert (1980), Remaudière and Keller (1980), Humber and Ben-Ze'ev (1981) and Ben-Ze'ev and Kenneth (1982b). This fungus, therefore, was considered to be a good test of the view outlined by Humber (1981), that "one of the most severe tests for a classification system is to see how well it can handle the least typical species from the group being classified."

MATERIALS AND METHODS

Specimens Examined

The following dried specimens were obtained from T. Petch's collection, through the courtesy of The Herbarium, Royal Botanical Gardens, Kew, England: package no. 9, labelled "*Entomophthora pyralidarum* Petch on moth, Kandy, January 1924, per G. M. Henry, ex Herb. Petch", containing a moth on a piece of leaf; package no. 10, labelled "*Entomophthora pyralidarum* Petch on moths, Vavuniya, Dec. 1923, ex Herb. Petch", containing a moth and remains of a second one; package no. 11, labelled "*Entomophthora pyralidarum* Petch on moths (Pyralidae), Peradeniya, Dec. 25, 1923, ex Herb. T. Petch", containing three moths and pieces of tree bark to which they were attached by rhizoids.

Four slides labelled "Acc. no. 6423 *Entomophthora apiculata* Thax. on Pyralid moth, Peradeniya, Ceylon, T. Petch 1924" were obtained from R. Thaxter's collection, through the courtesy of The Farlow Herbarium, Harvard University, Cambridge, Mass., U.S.A. The fungus in these slides was identified by A. G. Kevorkian, about or previous to 1935 (Dr. D. M. Pfister, Curator, The Farlow Herbarium, pers. commun.), which was prior to the description of *E. pyralidarum* by Petch (1937). The specimen from which these slides were prepared was examined by Dr. R. A. Humber (pers. commun.) and found to contain *Conidiobolus apiculatus*.

Microscopic Preparations and Measurements

Small portions were dissected from exsiccata and mounted for microscopic examination on glass slides, in lactophenol-cotton-blue (LPCB), in acetocarmine (Lee, 1950; Hall and Bell, 1963) or in safranin-O (Bandoni, 1979). Slides were gently heated over an alcohol flame to enhance staining and to exclude air bubbles.

The ocular micrometer used for measurements had a calculated error range of ± 0.6 µm. Diameters of flattened cylindrical structures were calculated using the formula $D = 2 \cdot \text{width}/\pi$.

RESULTS AND DISCUSSION

The specimens collected by Petch in Kandy and Vavuniya (packages nos. 9 and 10 from The Herbarium, Royal Botanical Gardens) and the specimen collected by Petch in Peradeniya and sent to Thaxter (slides obtained from The Farlow Herbarium) contained the same fungus, *Conidiobolus apiculatus*

(Thaxter) Remaudière & Keller. The specimens in Petch's collection were still labelled as "*Entomophthora pyralidarum*", indicating that they had not been reexamined, whereas the slides in Thaxter's collection were correctly labelled as *Entomophthora apiculata* (the synonym of *C. apiculatus* used until 1980). Package no. 11 in the Petch collection contained, side by side, one moth infected by *C. apiculatus* and two others infected by a species of *Erynia*. The moth infected by *C. apiculatus* was removed by the present author from specimen box no. 11 and was placed in a new box labelled "11a - *Conidiobolus apiculatus* on moth, Peradenyia, Ceylon, Dec. 25, 1923".

The description of *E. pyralidarum* (Petch, 1937) contains elements of *C. apiculatus*, together with elements of the *Erynia* sp., and apparently some elements of one or more Deuteromycetes which are also present in the specimens of the Petch collection. Accordingly, *Entomophthora pyralidarum* Petch 1937 is considered as a junior synonym of *Conidiobolus apiculatus* (Thaxter) Remaudière & Keller (= *Empusa apiculata* Thaxter 1888). The *Erynia* elements are described here as a new species.

Erynia neopyralidarum sp. nov., NON *Entomophthora pyralidarum* Petch 1937, Trans. Br. Mycol. Soc. 21: 36.

Conidiophora primaria ramosa, digitata, determinata. Conidia primaria uninucleata (? bitunicata), pyriformia, papillata vel papillata-apiculata (secundum Lakoni [1919] systema), 16.0-28.0 x 12.0-17.2 µm, papillae 1.2-4.6 µm altae; conidia secundaria conidiis primariis similia sed minoria, minime 13.7 x 9.2 µm, in conidiophoris brevibus ex conidiis primariis lateraliter orientibus portata. Sporae perdurantes sphaericae, subhyalinae, diametro 25.2-42.4 µm (med. 33.1 ± 3.9 µm), sporarum pariete 2.3-3.4 µm crasso, episporio leni; sporarum nuclei 2-7, ellipsoideis 5.7 x 6.9-8.0 x 9.2 µm. Rhizoidea filiformia, unihyphalia, aliquando ramosa, interdum apicem versus incrassata; pseudocystidia non visa. In Pyralidae (Lepidoptera) imagine, Peradeniya, Ceylon, Dec. 1923. Typus: exsiccati no. 11 "Erynia neopyralidarum, Peradeniya, Ceylon, Dec. 1923", et lamina per microscopium Erynia neopyralidarum designata, Ben-Ze'ev, no. 11 (I - VIII), Reg. Bot. Herb., Kew, Anglia.

Primary conidiophores are digitately branched, determinate and uninucleate in the conidiogenous cells (Fig. 1). Primary and secondary conidia are pyriform, uninucleate. Their nuclei (stained with acetocarmine -- Fig. 2) are entomophthoroid, relatively large (see dimensions and distribution in Table 1) spherical or more frequently ellipsoidal. The results of this study are ambiguous with regard to the conidial wall structure in *E. neopyralidarum*: a separable outer wall was observed in only three of 102 conidia screened (Fig. 3). Since *E. neopyralidarum* fits all other generic features-criteria of the genus *Erynia* as defined by Humber and Ben-Ze'ev (1981) and by Ben-Ze'ev and Kenneth (1982b), its conidia would be expected to be bitunicate rather than unitunicate. A similar scarcity of bitunicate conidia has been observed by the present author (Ben-Ze'ev, in preparation) in other *Erynia* species collected by Petch, although more bitunicate conidia were observed in the other species. It seems very likely that the unitunicate condition observed in the conidia of *Erynia* spp. in the Petch collection is an artifact caused by the preservation technique used by Petch, and that the bitunicate condition observed in some of these conidia reflects their true nature.

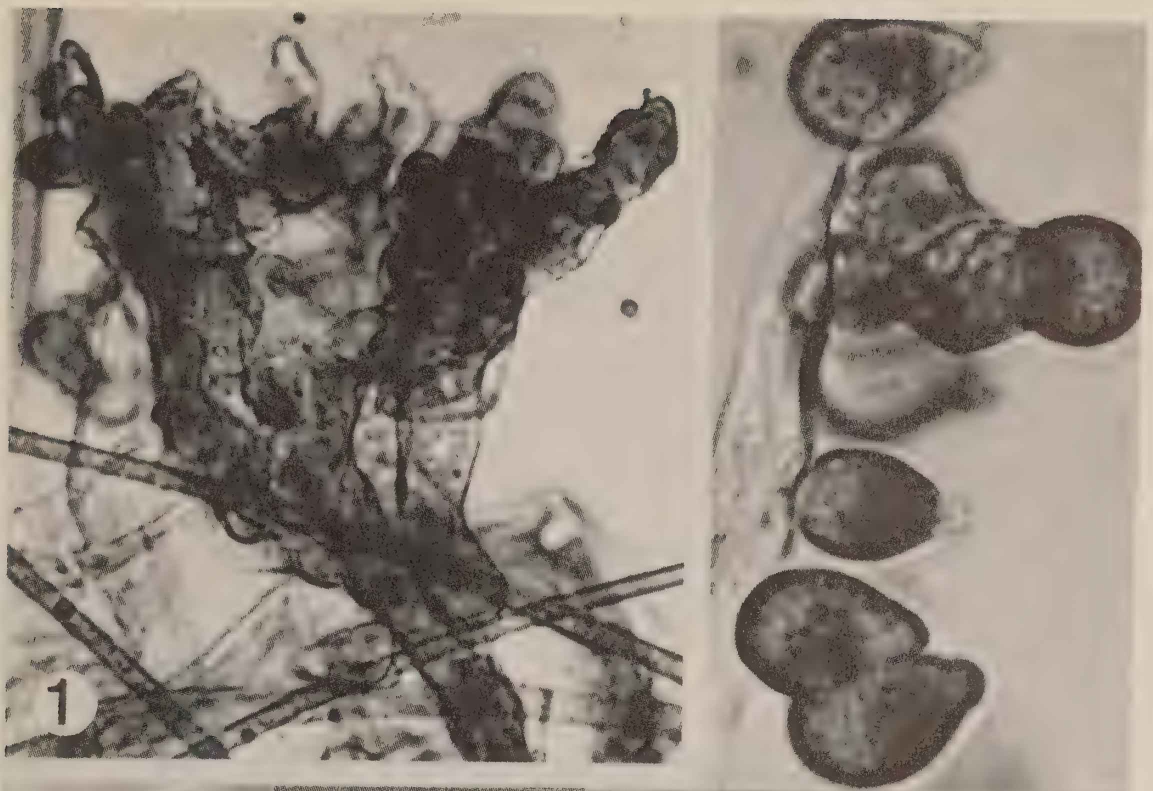
Dimensions of *E. neopyralidarum* conidia, and other conidial and resting spore parameters calculated in the present study and those given by Petch (1937) for *E. pyralidarum* are compared in Table 1. Conidia usually have acuminate papillae (Fig. 1) of *apiculata-type* [according to Lakon's (1919) classification], with a conspicuous or, more frequently, inconspicuous collar. On average, the papilla occupies 15.5% of the total conidial length and approximately 1/3 to 1/2 of the total conidial width. The ranges in length and width given by Petch for the pyriform or oval conidia coincide with the upper part of the range found in the present study (Table 1). Petch (1937) probably measured conidia on a moth collected soon after death and his range probably represented primary conidia or primary conidia with fewer secondary ones than were included in the range found in the present study. The fungus in the moths kept in Petch's collection, from which conidia were measured in this study, probably developed for a longer time, producing more secondary conidia. The present findings indicate that the length/width ratios of primary and secondary conidia of *E. neopyralidarum* are very similar making distinction between the two classes of conidia very difficult. The maximum dimensions of secondary conidia overlap the measurements of the primary ones and therefore, are not distinguishable, whereas the minimum dimensions in the range found, 13.7 x 9.2 µm, are the minimal dimensions of secondary conidia. These conidia are borne on short conidiophores arising laterally from primary ones (Fig. 3).

Resting spores of *Entomophthora pyralidarum* were described by Petch (1937) as "...zygospores (?), spherical, smooth, hyaline, 14-24 µ diameter...". Spherical structures matching this description were found in specimen no. 11 in the present study (Table 1) but they were probably not entomophthoralean resting spores. They were very thin-walled and stained uniformly in acetocarmine and safranin-O without showing nuclei, vacuoles or lipid drops (Fig. 4a). These spherical structures could belong to one of several Deuteromycetes present in Petch's specimens as mycelium, conidia, and possibly chlamydospores.

True entomophthoralean resting spores were found in the present study in one of the two moths in package no. 11 from Peradenyia which contained the other structures of *E. neopyralidarum*. They were found in mats of mycelium and hyphal bodies but their mode of production (as zygospores or azygospores) remains unclarified. These resting spores were much larger than those described by Petch (Table 1) and had a thicker wall consisting of a somewhat darker (subhyaline) episporium which was sometimes partly detached from the lighter, apparently bi-layered endosporium (Fig. 5). Resting spores stained in acetocarmine contained 2-7 nuclei/spore. These nuclei were more frequently ellipsoidal than were nuclei of conidia but were within the same range in

FIGS. 1-4: *Erynia neopyralidarum sp. n. on Pyralid moths, photographs from the type material in T. Petch's collection*

1. *Digitately branched conidiophores, x 500.*
2. *Primary (and possibly secondary) conidia stained with acetocarmine, showing nuclei and variously shaped papillae, x 1000.*
3. *Primary conidia with secondary conidiophores, two of them showing secondary conidia; the conidial outer wall layer is detached at the apex of the conidium in the lower left corner (probably by the pushing conidiophore), x 1000.*
4. *Unidentified spherical structures (a) possibly those interpreted by Petch (1937) as resting spores (arrows) together with conidia (b) stained with acetocarmine, x 500. Conidial nuclei are visible.*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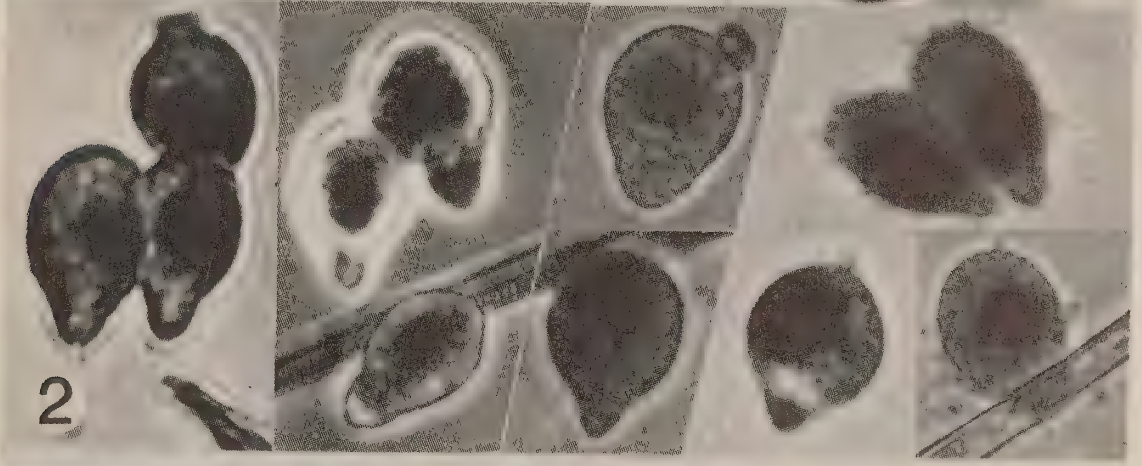
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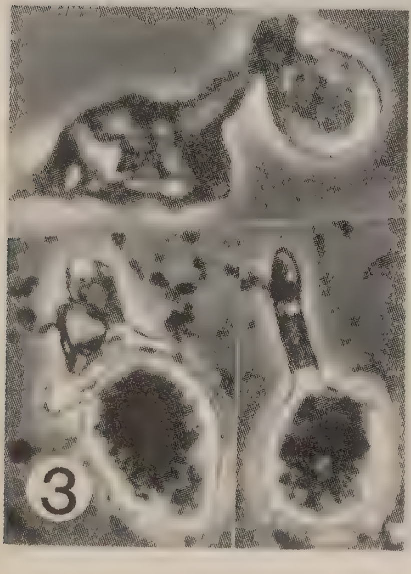
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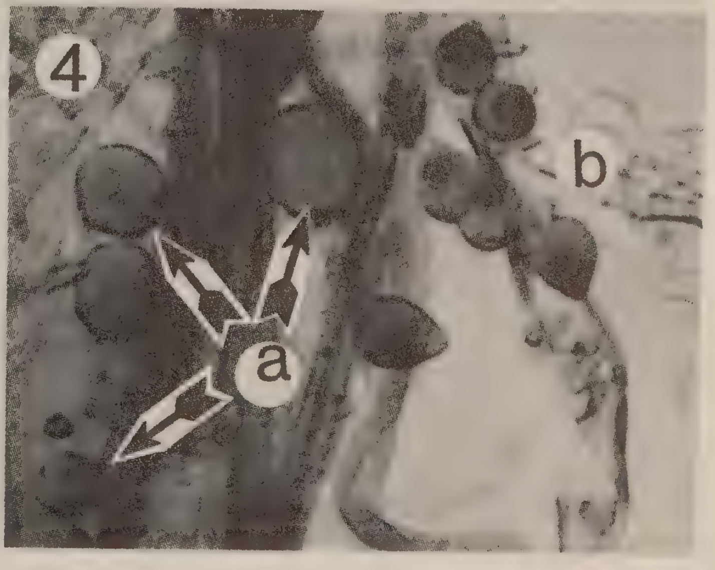
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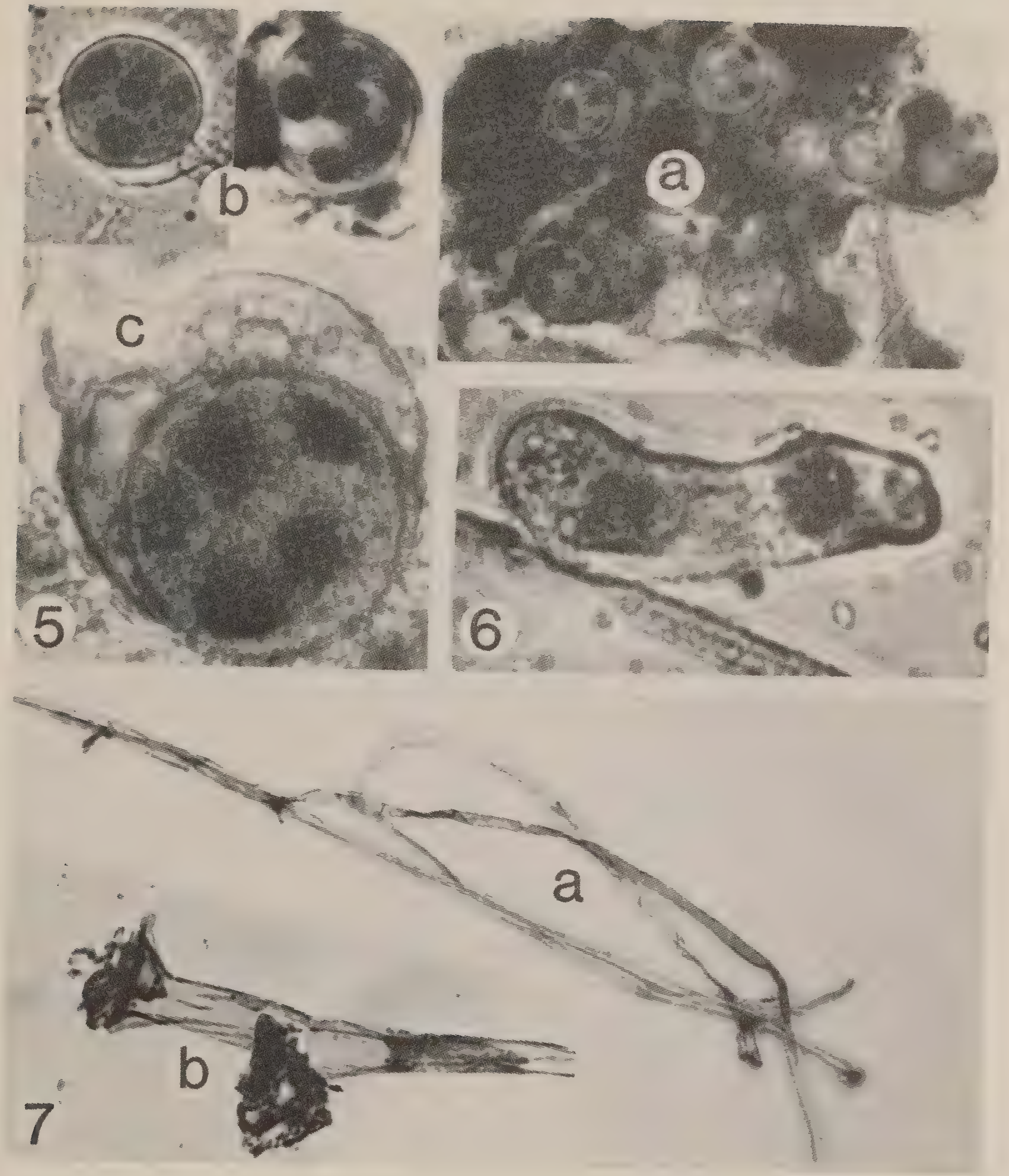
TABLE 1. *Quantitative features (parameters) of Erynia neopyralidarum. Those measured or calculated in this study are from Petch's specimen no. 11.*

Parameter	n	Present study	n	Petch (1937)
Conidial length X width (µm)				
min.-max. X min.-max.		13.7-27.6 X 9.2-17.2		16-28 X 12-16
$\bar{x}$ length (s; $s_{\bar{x}}$) X $\bar{x}$ width (s; $s_{\bar{x}}$)	102	18.4 (2.2; 0.22) X 12.1 (1.6; 0.16)	?	?
Conidial length/width ratio				
min.-max. ($\bar{x}$) (s; $s_{\bar{x}}$)	102	1.20-1.88 (1.53) (0.14-0.014)		
Conidial papillar height (µm)				
min.-max. (most frequent, 65% of measurements)	102	1.15-4.60 (2.30-3.40)		
Resting spore diameter (µm)				
min.-max. ($\bar{x}$; s; $s_{\bar{x}}$)	16	25.2-42.4 (33.1; 3.94; 0.96)		
wall thickness (min.-max.)		2.3-3.4		
Spherical structures considered resting spores by Petch (1937) - diameter (µm)				
min.-max. ($\bar{x}$; s; $s_{\bar{x}}$) wall thickness	37	8.0-22.9 (16.6; 3.17; 0.52) 1.0	?	14.0-24.0 ?
Conidial nuclei (µm)		approx.		
spherical min.-max.($\bar{x}$); %		5.7-8.0 (6.9) 45%		
ellipsoidal min.-max; %	82	5.7 X 6.9 5.7 X 8.0-9.2 } 45% 6.9 X 6.9-8.0 6.9-8.0 X 9.2 10%		
Resting spore nuclei (µm)		approx.		
spherical (diameter) min.-max.; %	*	6.9 20%		
ellipsoidal (length X width) min.-max.; %		5.7-8.0 X 6.9-9.2 80%		

*(2-7 nuclei/resting spore, measured in 16 spores)

size (Table 1). Hyphal bodies were usually short, unbranched, with few nuclei (Fig. 6). Chlamydospores, as described by Petch (1937) have not been observed in the material containing *E. neopyralidarum*. His description, however, seems to fit some of the hyphal bodies of *C. apiculatus* during formation of resting spores, as observed in the slides from



. 5-7: *Erynia neopyralidarum* sp. n. on Pyralid moths, photographs from the type material in T. Petch's collection

Resting spores stained with acetocarmine to show nuclei: (a) in a mycelial mat, x 250; (b) x 500; (c) resting spore with 5 nuclei and a partially detached episporium, x 1000.
Short, binucleate hyphal body (acetocarmine), x 1000.
(a) Monohyphal rhizoids showing ramifications (cotton blue), x 125; (b) bifurcate extremity of a rhizoid with two funnel-like holdfasts, x 500.

the Thaxter collection.

Rhizoids of *E. neopyralidarum* from specimen no. 11 were numerous, monohyphal, sometimes branched but not profusely so, with infundibuliform enlargements as holdfasts. Their filaments were devoid of cytoplasm at maturity appearing flattened in microscope preparations with a calculated diameter range of 10.2-20.4 µm (Fig. 7). Pseudocystidia were not observed by Petch or by the present author.

Type material of *E. neopyralidarum* is preserved as dried specimens and microscope slides at The Herbarium, Royal Botanical Gardens, Kew, England. In addition, original negatives and photographs of temporary microscope preparations are preserved at the same institution.

Conidia of *E. pyralidarum* described by Petch (1937) as "...globose, 18-28 µ diameter, with a conical papilla 4-8 µ high..." (source 5 in Table 2) were not encountered in the two moths of specimen packet no. 11 which contained *E. neopyralidarum* but were in a majority in the third one from this packet. The nuclei of these globose conidia were not stained by any of the stains used in the present study. These conidia were similar in shape to those of *C. apiculatus* found in specimen packages nos. 9 and 10, although they were significantly smaller (source 7 in Table 2). Moreover, the rhizoids on the moth containing these conidia were identical with those found in the other two packages (nos. 9 and 10) which contained *C. apiculatus*. These findings indicate that the third moth in package no. 11 was infected by *C. apiculatus* and that by the time it was collected most of the primary conidia had produced secondary or tertiary ones which are smaller than primary conidia.

A few conidia of *E. neopyralidarum*, each with a clearly visible nucleus, were observed in preparation no. 11a, prepared from the third moth in Petch's specimen no. 11, the one infected by *C. apiculatus*. Because the three moths containing the two different fungi were in the same package, actually in contact with each other for many years, mixing would be expected. This observation suggests how the two different species became mixed in the description of *E. pyralidarum* by Petch (1937).

E. neopyralidarum matches all the generic characters of *Erynia* Nowakowski emend. Humber and Ben-Ze'ev (1981), noting some ambiguity regarding the bitunicate condition of its conidia. Because its subgeneric characters are incompletely known, it cannot be included in any of the subgenera of *Erynia* in the classification of Ben-Ze'ev and Kenneth (1982b) and it is, therefore, placed in the temporary subgroup *Erynia sensu lato*. By having pyriform conidia with

TABLE 2. Comparative conidial dimensions of *Conidiobolus apiculatus*, *C. major* and *C. pseudococci*: (1)--*C. apiculatus* combined from various hosts, *C. major* on imago of *Ptilodactyla serricolis* (Coleoptera) - from Thaxter (1888); (2), (3) and (4)--*C. apiculatus* from Diptera and Psocoptera spp., (2) and (3)--*C. major* on a *Tipula* sp. (Diptera) and from a culture isolated from an aphid (Homoptera), respectively - from Gustafsson (1965); (5)--*C. apiculatus* (as *Entomophthora pyralidarum* - from Petch (1937); (6)--*C. apiculatus* on adult moth (Lepidoptera: Pyralidae) from Petch's specimen no. 9 of *E. pyralidarum* (prep. no. 9a, this study); (7)--*C. apiculatus*, secondary or tertiary conidia on adult Pyralid moth from Petch's specimen no. 11a, formerly *E. pyralidarum* (prep. no. 11a this study); (8)--*C. pseudococci* on *Pseudococcus calceolariae* (Homoptera), *() length and mean calculated here from Speare (1912, Pl. I, figs. d, e, f, k, j, k, q).

Source	*C. apiculatus* length x width	($\bar{x}$) µm	*C. major* length x width	($\bar{x}$) µm
(1)	30-37 x 28-30	(35 x 30)	55-60 x 38-45	(?)
(2)	25-39 x 21-30	(32 x 26)	40-64 x 37-55	(55 x 45)
(3)	24-37 x 19-25	(28 x 23)	37-69 x 35-55	(50 x 47)
(4)	18-32 x 16-27	(26 x 23)		
(5)	? x 18-28	(?)		
(6)	29.8-51.5x 20.6-45.8 (length s=3.14; width s=3.21; n=72)	(39.7 x 31.9)		
(7)	17.2-30.3x 12.6-27.5 (length s=3.78; width s=3.5; n=25)	(22.5 x 18.8)		
			C. pseudococci	
(8)			*(25.5-34.4)x 20-25 (length s=2.5; width s=1.9; n=7)	(32.3x23.9)*

an average l/w ratio of 1.5, which superficially resemble the conidia of the *Entomophaga grylly*-type, *E.neopyralidarum* is one of the least typical species in *Erynia* with regard to conidial shape. However, the exclusion of the conidioboloid elements changed the "anomalous" character of this species, as it appeared to be from Petch's description.

Remarks on *Conidiobolus apiculatus* and Related Species

Empusa apiculata Thaxter was first described by Thaxter (1888) in adults of various genera of Lepidoptera, in one lepidopterous larva, in numerous genera of small flies and gnats (Diptera) and in adult leafhoppers (Homoptera). One of the isolates studied by Thaxter was from a beetle (Coleoptera) and was similar to the other *E.apiculata* isolates, except for substantially larger conidia. This isolate was classified by Thaxter (1888) as *E.apiculata* var. *major*. These two variants were transferred by Gustafsson (1965) to *Entomophthora* as two independent species, *E. apiculata* (Thaxter) Gustafsson and *E. major* (Thaxter) Gustafsson.

Recently the two species were transferred to *Conidiobolus* by Remaudière and Keller (1980) as *C. apiculatus* Rem. & Kell. and *C. major* (Thax.) Rem. & Kell. Gustafsson (1965) reported isolation and growth of these species in artificial culture. He added Psocoptera (unidentified genera and spp.) to the host-range of *C. apiculatus*, and gall-midges (Diptera: Cecidomidae) to that of *C. major*. *C. apiculatus* was reported later to have killed aphids (Homoptera) in France (Thoizon, 1970), and in Israel and South Africa (Ben-Ze'ev *et al.*, 1981, and unpublished data).

To summarize, Petch's (1937) description of *Entomophthora pyralidarum* comprised: 1) branched conidiophores, found in the present reexamination to belong to *Erynia neopyralidarum*; 2) oval or pyriform conidia with conical papillae, demonstrated here to be uninucleate, probably bitunicate and belonging to *E. neopyralidarum*; 3) globose conidia with conical papillae, larger than the former ones, demonstrated in this study to be *Conidiobolus apiculatus*; 4) resting spores considered here to be of unknown origin, and demonstrated as different in size and cytology from the genuine resting spores of *E. neopyralidarum*; and 5) rhizoids which were insufficiently described by Petch (1937), and which according to his sketchy description could be those of either *C. apiculatus* or *E. neopyralidarum*.

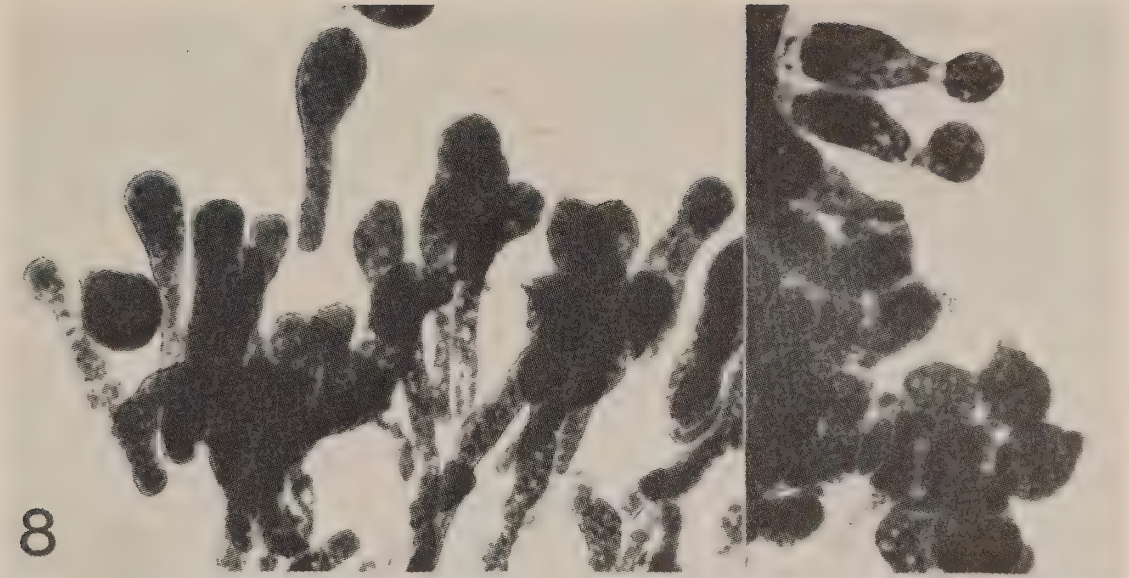
According to the most recent interpretation of the International Code of Botanical Nomenclature (13th International Botanical Congress, 1981) there were two possible resolutions to the classification of *E. pyralidarum*: 1) to exclude the conidioboloid elements and to propose a new combination, with an emended description for the *Erynia* elements, under the specific name "*pyralidarum*"; 2) to synonymize *E. pyralidarum* with the senior specific name, *C. apiculatus*, based on the conidioboloid elements, and to

FIGS. 8-10: *Conidiobolus apiculatus on Pyralid moths from T. Petch's collection, specimens nos. 9, 10 and 11a*

8. Simple conidiophores extended toward their apices, the two on the upper right corner with neck-like constrictions below the developing conidia, x 250.

9. Primary conidia (cotton-blue), the one on the extreme right with an apiculate papilla germinating to produce a secondary conidium, x 1000.

10. Characteristic monohyphal rhizoids, unbranched, with irregularly discoid holdfasts, x 125, the one on the extreme right, x 250.



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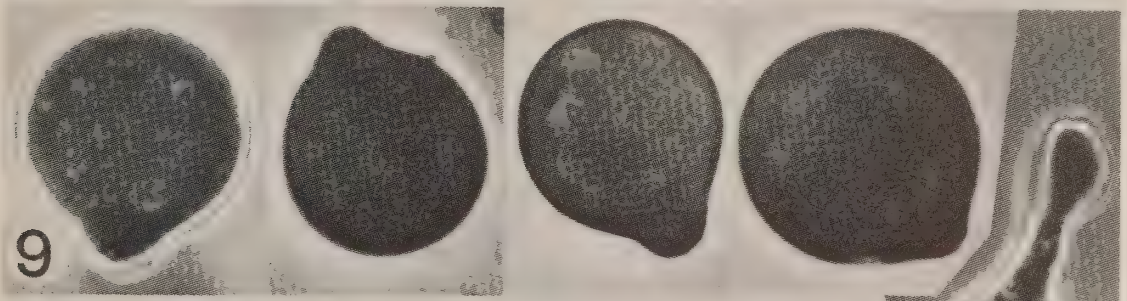

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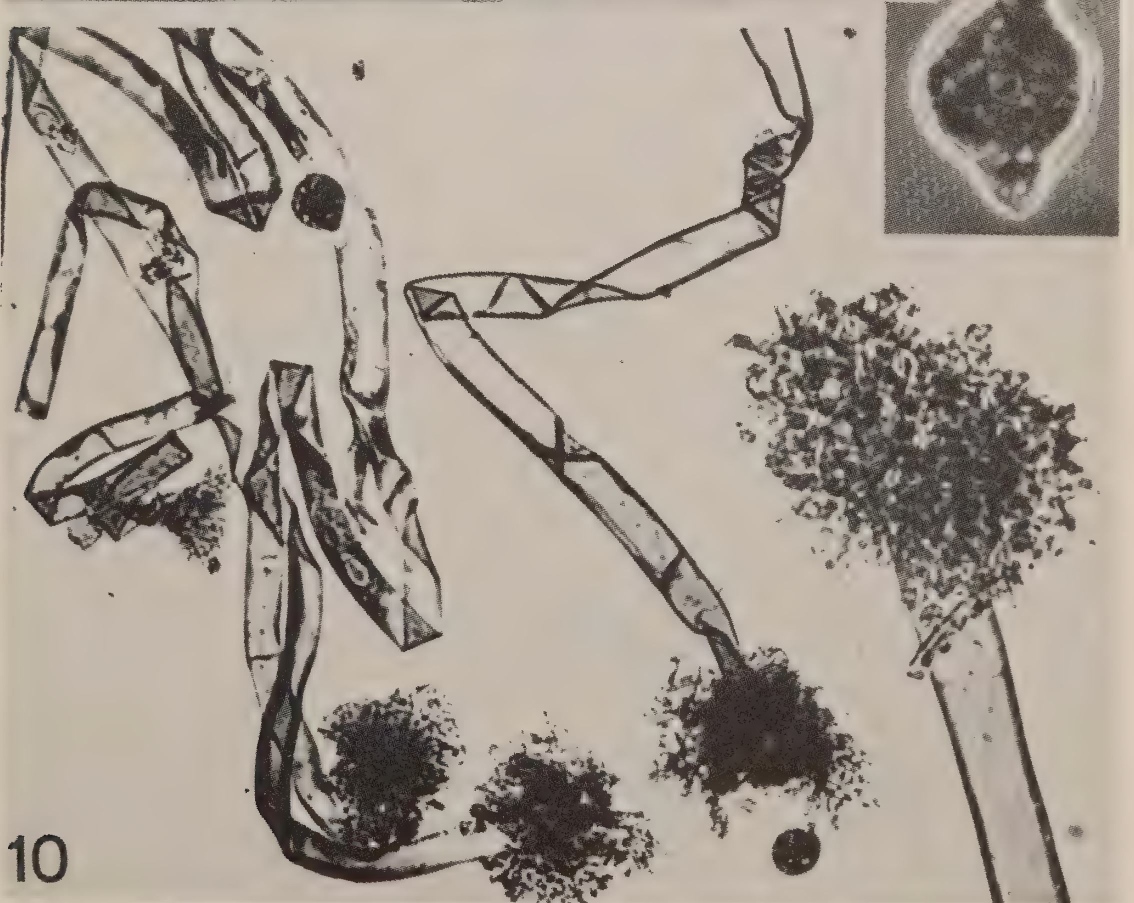

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describe the *Erynia* elements as a new species. The second solution was chosen because: 1) most of Petch's specimens contained *C. apiculatus*; 2) at the time that *E. pyralidarum* was described by Petch (1937) sufficient information about *C. apiculatus* was available to easily avoid a misdescription; and 3) the specimen sent by Petch to Thaxter was already identified as *C. apiculatus* in 1935 and was available if Petch wanted to reexamine it before publishing his findings from Ceylon in 1937.

Thaxter (1888) and Gustafsson (1965) described the conidiophores of *C. apiculatus*, under previous synonyms, as unbranched or slightly branched. The conidiophores of *C. apiculatus* observed in this study were unbranched with characteristic constrictions at the apices (Fig. 8) similar to those shown by Gustafsson (1965, Fig. 33) for *C. major*. The taxonomic importance of these constrictions was discussed by Humber (1981) and by Ben-Ze'ev and Kenneth (1982a). Primary, secondary and possibly tertiary conidia were measured from specimens nos. 9 and 11a and are compared in Table 2. In both of these specimens the conidia had apiculate papillae and the rhizoids were characteristic of *C. apiculatus* (Figs. 9 and 10).

Gustafsson (1965) included *Conidiobolus pseudococci* (Speare) Tyrrell & MacLeod (under its former name, *Entomophthora pseudococci* Speare [1912]) as a synonym of *E. apiculata*, because of similarity in conidial morphology, presence of rhizoids in both fungi and production of microconidia by *C. pseudococci* and by one of Gustafsson's isolates of "*E. apiculata*". A comparison of conidial dimensions of *C. apiculatus, C. major* and *C. pseudococci*.(Table 2) showed that conidia of *C. apiculatus* and *C. major* from Thaxter's study (1888) differed greatly in size. Conidia of *C. apiculatus* in Petch's specimen no. 9 were slightly larger in length and width than those of *C. apiculatus* described by Thaxter (1888) and substantially larger than those of Gustafsson's (1965) *C. apiculatus* isolates, but smaller by approximately 25% than conidia of *C. major*. The size of conidia did not allow a clear distinction between *C. pseudococci* and Gustafsson's isolates of *C. apiculatus*. Remaudière *et al.* (1979) compared different isolates of *Conidiobolus obscurus* (Hall & Dunn) Remaudière & Keller and concluded that there is substantial variability in the size of conidia within and among species with spheroidal conidia and that distinction according to this criterion is very difficult among such species. Thus, the differences in conidial size of the *C. apiculatus* isolates shown in Table 2 could be explained in consideration of the remarks of Remaudière *et al.* (1979), or could be attributed to the possibility that Gustafsson's sources (3) and (4) were not really *C. apiculatus*. This last possibility was discussed by MacLeod and Müller-Kögler (1973, p. 836) who suggested that Gustafsson's (1965) isolates that had smaller conidia than had Thaxter's isolate of *E. apiculata* and that produced microconidia were probably related to either *Conidiobolus pseudococci* or to *C. coronatus*.

Thaxter (1888) and Gustafsson (1965) noted, without providing measurements, that the ratio of papillar length to conidial length of *C. major* was smaller than that of *C. apiculatus*. Such conidial parameters as the absolute papillar length (APL), proportional papillar length (PPL), conidial length/width ratio (l/w), and apapillate conidial l/w ratio (AC-l/w) were calculated in the present study and evaluated as additional quantitative criteria to increase precision of differentiation among species with spheroidal conidia. A comparison of these parameters (Tables 2 and 3) showed that *C. pseudococci* differs from both *C. apiculatus* and *C. major* by having smaller conidia, a larger conidial l/w ratio and a much larger PPL. *C. major* differs from *C. apiculatus* by larger conidia (Table 2), larger resting spores (Gustafsson, 1965) and a smaller PPL (Table 3: 14.34% as compared to 16.10-17.38%). This apparently small difference in PPL between the two species is, however, substantial enough to be readily detected in Thaxter's (1888) drawings (Pl. 15, Figs. 63-70, var. *apiculata* vs. Figs. 71-73, var. *major*)*. The APL allowed good distinction between *C. major* and *C. apiculatus* or *C. pseudococci* but not between the latter two species. The AC-l/w ratios for the three species were about 1.0, meaning that their conidia without papillae were almost perfectly spherical. Although this ratio was of little value in differentiating these species, it could be useful when species possessing spheroidal conidia are compared with species that have ovoid or pyriform conidia, e.g. *C. apiculatus* vs. *E. neopyralidarum*.

It is concluded that Gustafsson (1965) was justified in elevating *C. major* to species level, but not in considering *C. pseudococci* to be a synonym of *C. apiculatus*.

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*See Thaxter (1888, p.194-195, DESCRIPTIONS OF THE PLATES). An error was made in the designation of drawings in his Plate 15.

TABLE 3. *Comparative conidial parameters of Conidiobolus apiculatus, C. major and C. pseudococci calculated here from the following sources: (1)--C. apiculatus from Thaxter (1888, Figs. 65-70), and C. major (l.c. Figs. 71-73); (2)--C. apiculatus on adult Pyralid moth from Petch's specimen no. 9 of Entomophthora pyralidarum (prep. no. 9a, this study); (3)--C. pseudococci on Pseudococcus calceolariae from Speare (1912, Pl. I. Figs. d, e, f, i, j, k, q).*

Parameter	*C. apiculatus*	
	(1)	*(2)*
Absolute papillar length (APL) min.-max. ($\bar{x}$) µm	*5.5-9.2 (7.4)*	*4.6-9.2 (6.4)*
standard deviation; n	*1.6; 6*	*0.9; 72*
Proportional papillar length (PPL) as % of average conidial length	*17.38%*	*16.10%*
Conidial length/width ratio (l/w) min.-max. ($\bar{x}$)	*1.1-1.3 (1.2)*	*1.1-1.4 (1.25)*
s; n	*0.09; 6*	*0.06; 72*
Apapillate conidial l/w ratio = length minus papilla/width (AC-l/w) min.-max. ($\bar{x}$)	*0.90-1.04 (0.99)*	*0.9-1.2 (1.04)*
s; n	*0.05; 6*	*0.04; 72*
	C. major *(1)*	*C. pseudococci* *(3)*
APL: min.-max. ($\bar{x}$) µm	*6.9-11.5 (9.2)*	*6.3-8.0 (7.3)*
s; n	*2.3; 3*	*0.7; 7*
PPL: %	*14.34%*	*22.71%*
l/w: min.-max. ($\bar{x}$)	*1.12-1.15 (1.14)*	*1.3-1.4 (1.35)*
s; n	*0.02; 3*	*0.03; 7*
AC-l/w: min.-max. ($\bar{x}$)	*0.95-0.99 (0.97)*	*1.01-1.09 (1.05)*
s; n	*0.02; 3*	*0.03; 7*

In addition to the conidial differences, *C.pseudococci* differs from the other two species by ability to produce microconidia and by different rhizoid endings (holdfasts). Among the 31 species classified in the genus *Conidiobolus* Brefeld (Ben-Ze'ev and Kenneth, 1982a) only *C. apiculatus, C. major, C. papillatus* (Thaxter) Rem. & Kell., and *C. pseudococci* are known to produce rhizoids. These four species are pathogenic to insects and their rhizoids are monohyphal, but the holdfasts of the first three are similar (Fig. 10), while those of *C. pseudococci* are different (Fig. 11b). Monohyphal rhizoids with holdfasts similar to those of *C. pseudococci* are produced by some species of *Erynia*, by *Entomophthora culicis* (A. Braun) Fres. (Gustafsson,1965; Ben-Ze'ev, unpublished) and by *Entomophthora destruens*

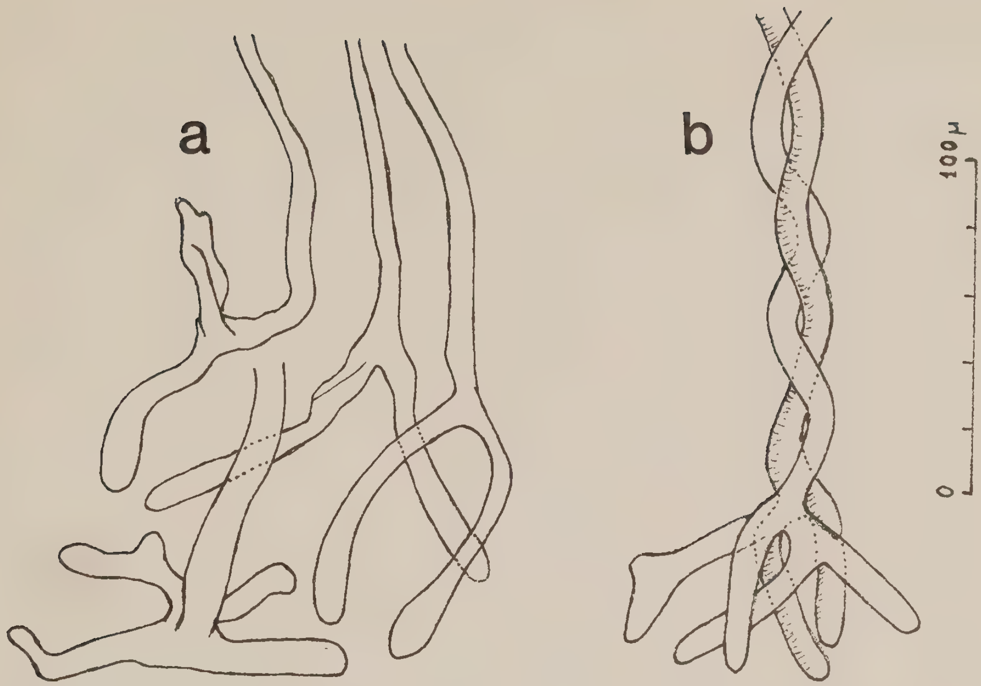

FIG. 11: *Conidioboloid rhizoids differing from those of Conidiobolus apiculatus:*

(a) distal extremities of Conidiobolus destruens rhizoids, redrawn from a drawing by Batko (in Weiser and Batko, 1966), and

(b) distal extremities of C. pseudococci rhizoids redrawn and brought to the same scale as (a) from a drawing by Speare (1912).

Weiser and Batko (1966, Fig. 2) (reproduced here in Fig. 11a). The last species, which has conidioboloid nuclei (R. A. Humber, pers. commun.) and all of the other generic characters of *Conidiobolus*, was suspected for several years to be synonymous with *C. thromboides* Drechsler (R. A. Humber, R. S. Soper, D. Tyrrell, pers. commun.). However, the production of rhizoids and loricoconidia (conidia which metamorphose into resting spores) described by Weiser and Batko (1966) establish this species as different from *C. thromboides*, whereas the conidioboloid characters justify the proposal of the following new combination.

> *Conidiobolus destruens* (Weiser & Batko), comb. nov. BASIONYM: *Entomophthora destruens* Weiser and Batko, *Folia Parasitol. (Praha) 13*: 145-146, Text-fig. 1-2, Pls. 1 (Fig. 1-3), 2 (Fig. 1-2), 1966.

Since *C. destruens* does not produce capilliconidia or microconidia, producing only Type I secondary conidia, it is placed in the subgenus *Conidiobolus* subg. *Conidiobolus* as defined by Ben-Ze'ev and Kenneth (1982a), close to the other three rhizoid producing species classified there, *C. apiculatus, C. major* and *C. papillatus*. Phylogentically, however, *C. destruens* appears to be closer to *Conidiobolus* (subgen. *Delacroixia*) *pseudococci*, because it has similar rhizoids. Other species placed in subgen. *Conidiobolus*, because they produce only Type I secondary conidia, appear to be related biochemically to either subg. *Delacroixia* (Sacc. & Syd.) Tyrrell & MacLeod or to subg. *Capillidium* Ben-Ze'ev and Kenneth (Tyrrell and MacLeod, 1972; King, 1976; Ben-Ze'ev & Kenneth, 1982a, p. 422 and 428-431). These phylogenetic problems encountered with species of the subgenus *Conidiobolus* suggest that this subgenus is phylogenetically artificial, undoubtedly containing some species that are more closely related to the other two subgenera but that have lost the ability to produce microconidia or capilliconidia. From the systematic point of view it is convenient to retain the subgenus *Conidiobolus* until additional knowledge allows broader definitions for the other subgenera of the genus *Conidiobolus*.

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SURVEY OF THE ARGENTINE SPECIES OF THE *GANODERMA LUCIDUM* COMPLEX.

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SUMMARY

Macro and micromorphological and cultural studies showed that the *Ganoderma lucidum*-complex is represented in Argentina by *Ganoderma lucidum s. str.*, *G. oerstedii*, *G. resinaceum*, *G. zonatum* and *G. subamboinense var. laevisporum* var. nov. based mostly on the study of type materials. A general key is presented in this complex and additional synonyms for *G. resinaceum* are proposed. *G. tuberculatum* is a synonym of *G. oerstedii*.

The species of the *Ganoderma lucidum* (Leys.:Fr.)Karst. complex are important wood-rotting fungi and cover a wide array of hosts in Argentina: *Tipuana*, *Acacia*, *Robinia*, *Ocotea*, *Pinus*, *Quercus*, *Ulmus*, *Acer*, etc., inflicting serious damage both to native and introduced trees. The group is formed by those species possessing a typical "hymenodermis" (Steyaert, 1972).

Unfortunately they have been poorly studied, particularly for Central and South America. Thus, we lack modern keys for their identification (cfr. Murrill, 1915; Dennis, 1970), and those that are available are not sufficiently comprehensive and are based almost entirely on macromorphological features. A study was thus carried out on most of the species of the area having a hymenodermis, particularly on Argentine forms. This has allowed us to develop a tentative key of the representative species and varieties from Central and South America, with major emphasis placed on the basidiospores .

The genus *Ganoderma* was created by Karsten (1881) based on *Polyporus lucidus* Leys.:Fr., the type of which is not extant. It comprises those species of polypores whose pileus and stem (when present) are covered by a crust with the consistency and appearance of lacquer, sometimes brilliant, and with ovoid to ellipsoid basidiospores varying from yellow to brown, provided with a hyaline perisporium that is usually smooth and truncate, and a thick endosporium with projections reaching to the external layer (Heim, 1962; Furtado, 1962, 1965). The apex becomes truncate upon maturation due to the collapse of the apical papilla. Until recently the genus was included in the Polyporaceae but Donk (1933) segregated the subfamily Ganodermoideae which he later gave family rank as *Ganodermataceae* (Donk, 1964).

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Since Patouillard (1889) revised the species to that date, several workers dealt with the genus, describing numerous species, among them Murrill (1908b, 1915), Lloyd (1912, 1915, 1917, 1920, 1921, 1924), Torrend (1920), Spegazzini (1926), Imazeki (1939), Rick (1938), and mainly Steyaert (1961a and b, 1962, 1967b, 1972). Steyaert's untimely death prevented him from writing a monograph of the genus (but cfr. Steyaert, 1980).

In spite of the work carried out by these workers, the taxonomy of the genus has been, and still is, rather chaotic, principally due to the great variety of forms encountered and the different criteria used for classification. It is now obvious that macromorphology alone is useless as a basis for distinguishing among species.

New criteria arose after the studies of Humphrey & Leus (1931) and of Haddow (1931). The former though referring only to the *G. applanatum-complex* (another difficult problem), emphasized the importance of employing anatomical characteristics in their classification. Haddow (1931) was the first to use the structure of the fruit-body's dermis for the identification of a few species, but did not propose any descriptive terminology; he did, however, refer to the spore ornamentation as the "smooth type" in *Ganoderma sessile* (=*G. resinaceum*) and the "rugose type" in *G. lucidum*. This was later confirmed by Steyaert (1962, 1972). For our species concept we have emphasized the type of spore ornamentation, shape and size, the number of pores per mm and, in some instances only, the colour of the context. The latter has been widely used by previous authors but is not always a reliable feature. Studies with the SEM corroborated the structure of the spore wall proposed by Furtado (1962) as well as the types of ornamentation proposed by Steyaert (1972), to which we have added the "semirugose type" intermediate between the typically "smooth" and "rugose" types. Steyaert (1962, 1972, 1980) considered that the different forms constitute constellations or "complexes" according to the types of dermis, which were defined and carefully studied by Furtado (1965). All the species here described fall in Steyaert's (1980) subgenus *Ganoderma*, Section *Ganoderma*, although some related ones included in the key do not.

MATERIALS AND METHODS

The description of the basidiomes was made according to their macroscopic features (size, colour, number of pores per mm, length of tubes, colour and consistency of context, presence or absence of stem, etc.). The microscopic features studied were the types of hyphae, and the vegetative and reproductive structures, mostly using the indications given by Teixeira (1956). The hyphal system was studied by dissecting small portions of the context and/or the dissepiments. Dermic elements were examined and measured in thin sections perpendicular to the pileus surface. Spore ornamentation and gasterospore[1] features were studied both with the optic and SE microscopes.

Cultural studies "in vitro" were made of some species according to the methods of Nobles (1948, 1958, 1965), and code numbers obtained.

Colours are according to Maerz & Paul (1930), and herbarium abbreviations those of Holmgren & Keuken (1974).

KEY TO REPRESENTATIVE SPECIES OF THE *GANODERMA LUCIDUM-COMPLEX* TO BE FOUND IN CENTRAL AND SOUTH AMERICA.

1. Spore ornamentation distinctly rugose........................2
1'.Spore ornamentation not so....................................3

2. Context dark brown; spores 9-13 x 5-6,9 µm.....*G. lucidum s. str.*
2'.Context almost white; spores broadly ellipsoid,
8-9 x 5-7 µm.......................*G. punctisporum* Furtado

3. Spores of the "smooth" type (with numerous slender endosporic pillars that do not show up on the perisporium, thus appearing smooth when observed with the optical microscope at 400 x)..........................4
3'.Spore ornamentation "semirugose, intermediate between that of 1 and 3......................................8

4. Gasterospores present in context and dissepiments..........5
4'.Gasterospores absent..6

5. Gasterospores with walls formed by veins or ribs (particularly evident with the SEM); Brazil...
.........*G. subamboinense* P.Henn.
var. *subamboinense*
5'.Gasterospores with smooth walls; Brazil and NE Argentina.............................*G. subamboinense* P.Henn.
var. *laevisporum* var. nov.

6. Pores 3-5 per mm; spores ellipsoid, 9-13 x
5-8 µm ....*G.resinaceum* (Boud.)Pat.
6'.Pores usually larger than 5 per mm......................7

7. Pores 5-6 per mm; spores 7-10 x 5-7 µm, context
almost white...........................*G. parvulum* Murr.
7'.Pores 6-7,5 per mm, mostly 7 per mm, spores
9-10 x 5-7 µm, context brown..........*G.bibadiostratum* Steyaert

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[1] Term used in the sense of Steyaert and employed much earlier by Spegazzini for imperfect spores on or in normal basidiomes.

8. Context dark brown................................9
8'. Context almost white or, at least, not dark brown; basidiomes generally small and sessile; spores 9-11 x 6-8; Mexico ....*G. sessiliforme* Murr.

9. Spores broadly ellipsoid, 9-14 x 6-10 µm; pores 4-7 per mm, surface of pileus usually strongly tuberculate.........*G. oerstedii* (Fr) Torr.[1]
9'. Spores narrower, pileus surface not distinctly tuberculate...................................10

10. Spores 11-13 x 5-7 µm; pores 4-5 per mm; surface of pileus smooth or concentrically sulcate.................*G. zonatum* Murr.
10'. Spores 10-11 x 5-6 µm; pores 5-6 per mm; surface of pileus radially rugose and concentrically sulcate.......*G. subfornicatum* Murr.[1]

GANODERMA P.Karst., Rev. Mycol. 3 (9): 17.1881, emend Patouillard, Bull. Soc. Mycol. France 5: 67. 1889

Xylophagous polypores producing a white-rot in wood. Basidiome annual or biannual, rarely perennial, pileate. Pileus with an eccentric stem, or sessile and then dimidiate, rarely centrally stipitate. Pileus and stem surfaces (when present) covered with a crust with the consistency and appearance of lacquer which may or not be shiny like varnish, well defined, generally brilliantly coloured. Context corky, fibrous-coriaceous, or somewhat woody, more or less tomentose or fibrillose, sometimes very hard and durable, with various hues of brown, frequently whitish, sometimes with a thin dark brown layer among the tubes. Hymenophore tubular, in one or several layers, generally dark, with a smooth surface. Pores small, mostly circular, almost white, exceptionally golden yellow. Hyphal system trimitic with hyaline, septate, clamped, thin-walled generatives, usually branched and more frequent at the margin. Skeletal hyphae aseptate, thick-walled, light brown, long, wavy, scantily branched,occasionally with dendritic endings, generally more frequent in the context. Binding hyphae scarce, strongly branched and tortuos , aseptate, thick-walled, more slender than the skeletals. Cystidia and setae absent. Basidia short clavate to napiform, 4-spored. Spores ovate-ellipsoid, with a truncate apex and a two-layered cyanophilous wall, the external smooth and hyaline, the internal brown, verrucose or reticulate.
Type species: *Ganoderma lucidum* (Leys.:Fr.)P.Karst.

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[1] Both species belong to Section Characoderma, according to Steyaert (1980).

GANODERMA LUCIDUM (Leys.:Fr.)P. Karst., Rev. Mycol. 3 (9): 17.1881.

= *Boletus lucidus* Leys. Fl.Halensis p. 300. 1783. = *B. dimidiatus* Thunb., Fl. p. 348, tab. 39. 1784 (Fide Imazeki). = *B. laccatus* Timm, Fl. megalop. Prodr., p. 269. 1788 (Fide Imazeki). = *Polyporus lucidus* Leys.:Fr., Syst. Mycol. I: 353. 1821. = *P. laccatus* Timm:Pers., Mycol. europ. 2: 54. 1825 (Fide Imazeki). = *P. japonicus* Fr., Epicr. p. 442. 1838 (Fide Imazeki). = *F. lucidus* (Leys.:Fr.)Sacc.,Syll. Fung. 6: 157. 1881. = *Placodes lucidus* (Curt.:Fr.)Quél., Fl. Mycol. p. 399. 1888 (Fide Domański). = *F. japonicus* Fr. in Sacc., Syll. Fung. 6: 156. 1888 (Fide Imazeki). = *Ganoderma pseudoboletus*(Jacq.) Murr., Bull. Torrey bot. Cl. 29: 602. 1902 (Fide Imazeki). = *G. laccatum* Pat. in Bresadola, Icon. Mycol. 21, t. 1004. 1932, non *G. laccatum* Bourd. & Galz. 1928. Icon. Michael & Henning, Pilzfr. 2, t. 73. 1960 (Fide Domański et al.).

Figs. 1-4, 23-25, 61.

Annual, sessile and dimidiate or, more frequently with a lateral stem and then usually reniform (Figs. 1,3). Pilei isolated, small to medium sized, 2-8 x 2-4,5 x 0,5-2 cm. Pileus surface radially rugose and concentrically sulcate, brilliantly laccate, light reddish brown (Pl. 6 L 12 of Maerz & Paul), to dark reddish brown or mahogany (Pl. 7 L 6). Margin sterile, generally thick and blunt, sometimes acute, white in actively growing specimens, becoming yellowish and reddish brown inwards; in older specimens of the same colour as pileus surface, and then incurved. Stem lateral, vertical, cylindric, usually long, slender, tortuous, 4-10 cm long,0,5-2 cm thick, reddish black to almost black, laccate, brilliant, somewhat thicker at the base. Cutis thin, brilliant black. Context almost as thick as the tube layer but thickening towards the base of the stem, ochraceous brown when young (Pl. 13 H 10) to dark brown when mature (Pl. 14 L 12), corky. Dermis of the "hymenodermis" type, composed of thick, golden walled, claviform elements originating from the ends of skeletal hyphae, with narrow lumina and blunt ends, arranged in a palisade-like hymenium (Fig. 62), 5-10 µm thick, the total thickness of the dermis 14-42 µm. These elements are covered by a thick layer of a lacque-like substance that dissolves in a hot solution of 5% KOH. Hymenophore white to yellowish white when young, greyish white in mature specimens (Figs. 2, 4) with a tube layer up to 7 mm long, slightly lighter than context (Pl. 13 D 8). Pores small, round, somewhat irregular, 4-7 per mm, 6-200 µm diam. Dissepiments 17-116 µm diam. Hymenium not persistent, composed of scant globose to subglobose basidia, 9-19 x 7-14 µm. No other hymenial elements present. Basidiospores subovoid with the apex truncate, perisporium hyaline, smooth and thin, and endosporium golden with relatively scant endosporic pillars, wide and long, reaching the perisporium and rumpling it so that it appears strongly "rugose" (Figs. 23-25, 61); 9-13 x 5-6,9 µm. Hyphal system trimitic with hyaline,thin-walled,clamped,septate generatives, 1-4µm diam.,septa restricted to clamps, scantilybranched, abundant at the growth margin of pileus and dissepiments, rare or absent in the context (Fig. 71). Skeletals "arboriform" (Teixeira, 1956), aseptate, clampless, very long, 3-6 µm diam., scantily branched, branches with limited growth at distal end, with thick golden walls, sometimes subsolid; they compose most of the context and dissepiments, originating immediately behind the growth margin from generative hyphae (Fig. 68). Binding hyphae of the "Bovista" type (Cunningham,1946a), aseptate, clampless, profusely branched, tortuous, of limited growth, generally thinner and lighter than the skeletals, 1-3 µm diam., rather scant and only present in the context; they are intertwined with the latter, giving the context its firm cohesion (Figs. 69-70).

Hosts: at the base of trunks and on roots of harwoods, rarely on conifers. Recorded also on *Acer, Quercus, Castanea, Alnus, Populus, Fagus, Fraxinus* and *Pinus* (Domański, 1967). According to Domański (loc. cit.) it grows saprophytically and only exceptionally attacks living trees. Boyce (1938) agrees with this. However, Pirone (1957) through experiments with *Acer* proved that it is an important parasite of hardwoods.

Distribution: apparently worldwide in temperate and tropical zones. It has been recorded for Europe, Asia, Philippines, Australia, Africa and North and South America (in the latter for Venezuela, Brazil, Uruguay and Argentina).

Apart from the records given below for Argentina, Spegazzini cited collections from the provinces of Córdoba and Chaco. We have been unable to find materials from those areas.

Material studied: ARGENTINA: Buenos Aires: Don Torcuato, leg. Kohn, 10.IX.1970 (BAFC 24406); Pereyra Iraola, IV.1971 (BAFC 24421); Bella Vista, leg. Gallardo, 31.I.1965 (BAFC 25531). Capital Federal: Jardín Botánico, leg. Molina, 7.IV.1978 (BAFC 24408). Corrientes: 4 km E of Paso de la Patria, leg. Krapovickas, 20.V.1966 (BAFC 24428). Misiones: Parque Nacional Iguazú, leg. Bazzalo, 14.III.1980 (BAFC 25055); Garupá, leg. Cricel, 16.IV.1976 (BAFC 24433); Arroyo Yacuy, leg. Gómez, I I.1969 (BAFC 24418). Tucumán: road to Tafí del Valle, km 19, leg. Gómez, 22.V.1966 (BAFC 24419); road to El Cadillal, Hway 9, leg. Ruiz, 26.IV.1973 (BAFC 24425); ibid., leg. Guerrero & Bettuci, 27.I.1965 (BAFC 25524); no locality, leg. Spegazzini, VI.1917 (LPS 24886). BRAZIL: Sao Leopoldo, leg. Rick (sub *G. renidens*) (BAFC 25599). FRANCE: Basses Pyrénees, leg. Candousseau, 1972 (BAFC 25600). URUGUAY: no locality, leg. Berg (LPS 24851); Montevideo, leg. Arechavaleta, IX.1898 (LPS 24972); ibid., Cerro Largo, leg. Felippone (LPS 24882).

Figs. 1-4: *Ganoderma lucidum s. str.* 1-2: aspect of basidiome; 3: surface of pileus; 4: hymenophore. Figs. 5-6: *Ganoderma subamboinense* var. *laevisporum*. 5: surface of pileus; 6: hymenophore (all figures 1/2 x).

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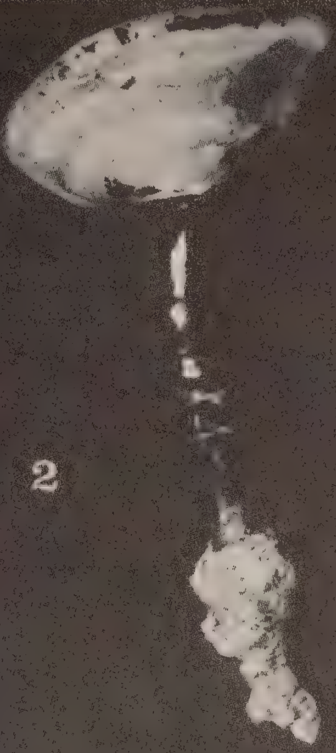
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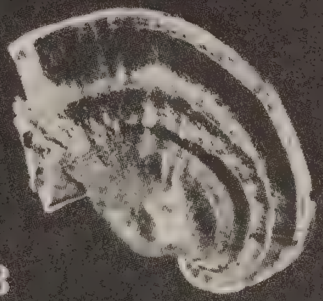
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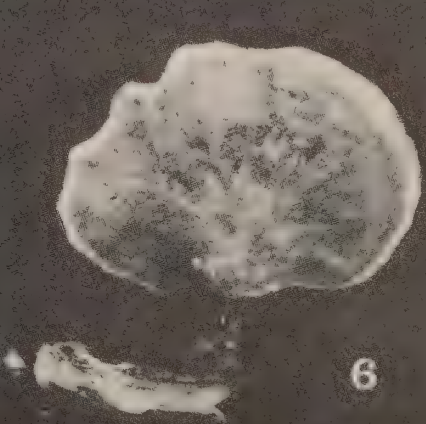
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Cultural features Figs. 75-79, 81-82, 88-90, 107.

Strains: BAFC n°112 = ARGENTINA: Catamarca, Dique de Collagasta leg. Laterra, 14.I.1981. BAFC n°815 = ibid.

Code Number: 2. 3. 8. 10. 37. 39. 45. 53. 54. 55.

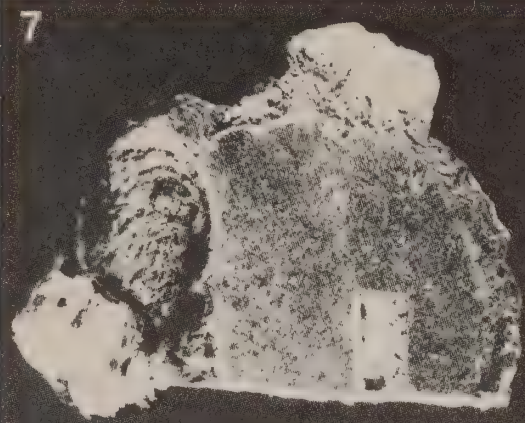
Macroscopic characters: growth slow, covering Petri dishes in 5 weeks. Mycelium mat not dense, adhering to agar, arranged in concentric bands the 1st week, alternatively white and ochraceous (Pl. 11 K 1). After the 4th week it becomes totally ochraceous yellowish with more or less darker concentric bands (Fig. 107). Texture completely farinaceous, margin subfelty. Reverse:discoloration brown. Margen regular, border smooth. Odour sweetish. Oxidase reaction: with tannic acid= ++++ with growht; with gallic acid= ++++ without growth; with gum guaic = +.

Microscopic features: marginal mycelium formed only by generative, clamped hyphae, with septa restricted to clamps, scarcely branched, 2,5 µm diam. (Figs. 88-90); during the 2nd week fibrous hyphae appear, slender, hyaline, thick-walled, clampless, heavily branched, 1-2 µm diam. (Figs. 77-78). Ochraceous yellowish mycelium formed by: i) generative hyhae as above; ii) clamped, thick-walled hyphae, golden, unbranched, 2-7 µm diam., of uniform thickness or like rosary beads (Figs. 79, 81-82); iii) stag-horn clamped hyphae, thick-walled , with numerous branches, generally dichotomic, projecting in several planes, 1-3 µm diam., or with short branches laterally disposed in a single plane at regular intervals, 2-3 µm diam.; iv) globose, thin-walled golden yellow cuticu lar cells which are very abundant, tightly packed forming a "pseudoparenchyma", 5-20 µm (Figs. 75-76); v) fiber hyphae as in the margin, scarce. Submerged mycelium similar to aerial.

These cultures are characterized by a strong yellowish colour that extends to all the mycelial layer, whereas in other species it is limited to a few spots and is not so intense. The cultures resemble those of *G. subamboinense* var. *laevisporum* but differ in the lack of chlamydospores.

For a long time the *G. lucidum*-complex has been a difficult problem for taxonomists. It has been a tradition to consider all the stipitate forms as *G. lucidum s. str.* and the sessile ones as *G. resinaceum* (= *G. sessile* Murr.). This distinction has an absolute lack of anatomical foundation. When one deals with a large number of specimens, clear distinctions appear with regard to spore ornamentation, whatever the macroscopic configuration may be. This had already been observed by Haddow (1931) and was only reconfirmed 35 years later by Steyaert (1967a). Haddow termed the spores of *G. lucidum* as of the "rugose" type. Unfortunately the holotype of this species has not been found, although Steyaert (1972) states there is a coloured illustration of such specimen in Flora Londinensis (1781), which was collected at Peckham, S of London. This would constitute the pres-

Figs. 7-8. *Ganoderma sessile* (Holotype). 7: hymenophore; 8: surface of pileus, 9-10. *G. resinaceum*, BAFC 24450. 9 hymenophore; 10: surface of pileus. 11-12. *G. subamboinense* var. *laevisporum*. 11: aspect of the basidiome; 12: hymenophore (all figures 1/2 x).



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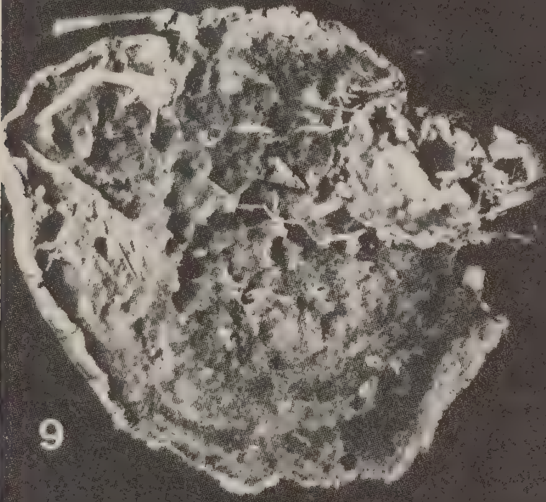

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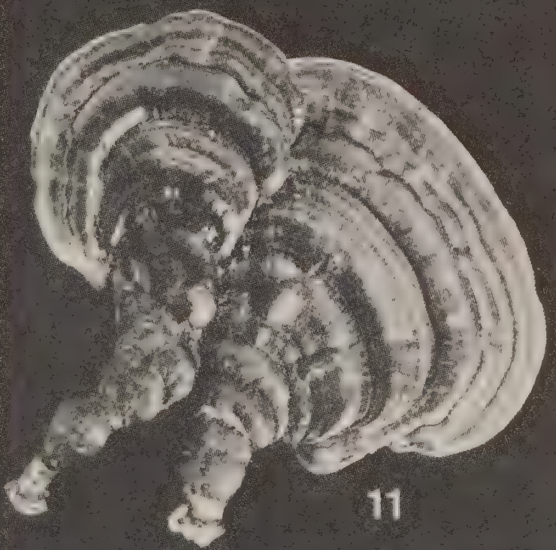

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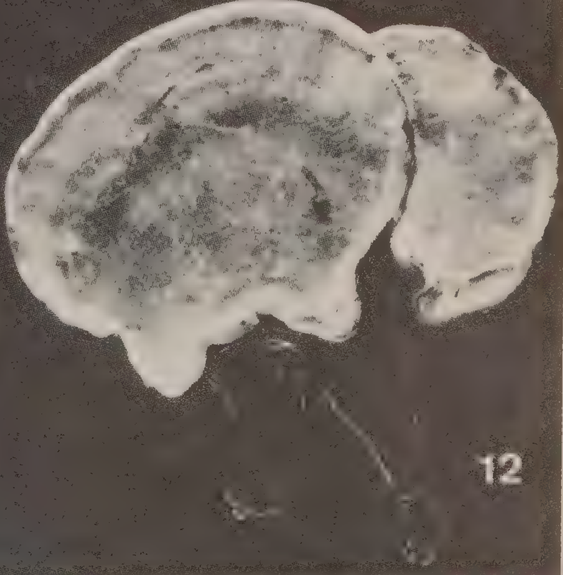

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ent type of the species. However, such an illustration does not reveal the spore features. Attempts to find a neotype at Peckham have failed. Karsten, the founder of the genus, left at H a specimen with the same type of "rugose" spores (Steyaert, 1972), which could be selected as neotype and thus arrive at a satisfactory "modus vivendi" to distinguish among both species.

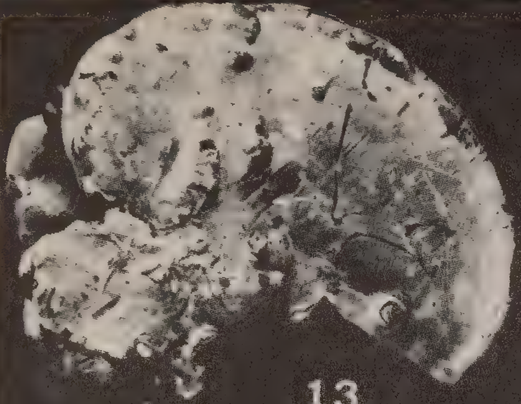
GANODERMA SUBAMBOINENSE P. Henn. Fungi amazonici I. Hedwigia 43: 175. 1904 (sub *Fomes* (*Ganoderma*) *subamboinensis*) var. *LAEVISPORUM* var. nov.

Figs. 5-6, 11-12, 46-50, 62-71.

A typo differt gasterosporis laevis. Holotypus Argentina, Buenos Aires, Tigre, leg. Connon, 15.V.1980, in Herb. BAFC 25525 conservatus est.

Annual, sessile, dimidiate or, more frequently, stipitate flabelliform to conchate, pleuropus, with isolated pilei which are sometimes concrescent, small to medium-sized, 3,5-13 x 2,5-10,5 x 0,2-1,5 cm. Pileus surface radially rugose with concentric, slightly deep sulcations, or radially rugose and then with numerous, deep, concentric sulcations, that make it appear undulate (Figs. 5, 11); dark reddish brown (Pl. 7 L 11 of Maerz & Paul), gradually becoming lighter towards the margin, with a narrow yellowish-orange band (Pl. 11 J 7) in young specimens; in mature ones this graduation is not observed, the colour tending to become homogeneous, brilliantly laccate. Margin sterile, straight, yellowish white (Pl. 11 B 1), thin and acute to thick and blunt; in the first case undulate and somewhat irregular; in the second smooth and regular. Stem horizontal, short and thick or long and slender, tortuous, reddish black to almost black, laccate, brilliant, cylindric, 1,5-5,5 cm long, 0,5-2,5 cm thick. Section very thin in general, slightly swollen at the base, 0,3-1,5 cm deep at about half the radius. Cutis thin, black, brilliant. Context thin, up to 1 cm thick, light brown, almost white (Pl. 11 D 5), slightly darker in a narrow zone above the tubes; in the Brazilian specimensbrown (Pl. 13 H 8); corky. Dermis of the "hymenodermis" type, composed of clavate elements with thick walls and blunt ends, 5-10 µm diam., covered by a thick layer of lacquer that dissolves in a hot solution of KOH (Fig. 62); 16-36 µm thick. Hymenophore poroid, concolorous with margin, tube layer 1-4 mm long, concolorous (Figs. 6, 12); pores circular, 4-7 per mm, 98-260 µm diam., dissepiments 36-170 µm. Hymenium formed only by easily collapsing subglobose basidia, 4-spored, 9-13 x 7-14 µm (Fig. 57). Basidiospores broadly ellipsoid with truncate apex (Figs. 46-50), of the "smooth" type, perisporium hyaline, thin, endosporium light

Figs. 13-16. *G. oerstedii*. 13-14: aspect of the basidiome (BAFC 24441); 15-16: aspect of the basidiome (Holotype of *G. tuberculosum*) (both 1/4 x). Figs. 17-22. *G. zonatum*. 17-19: aspect of the basidiome of the Holotype (1/2 x); 20-22: aspect of the basidiome of BAFC 24416 (1/2 x).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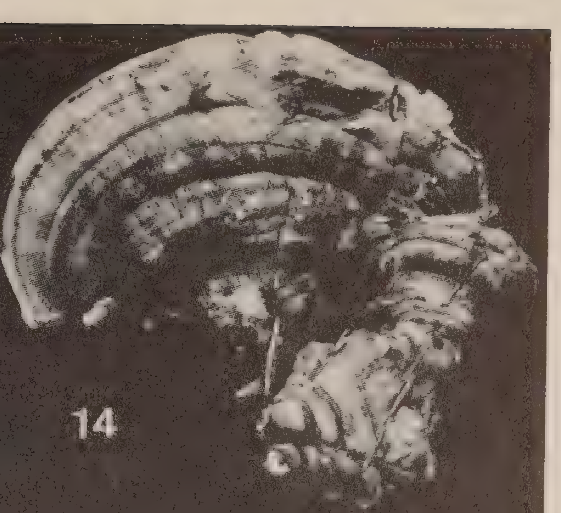
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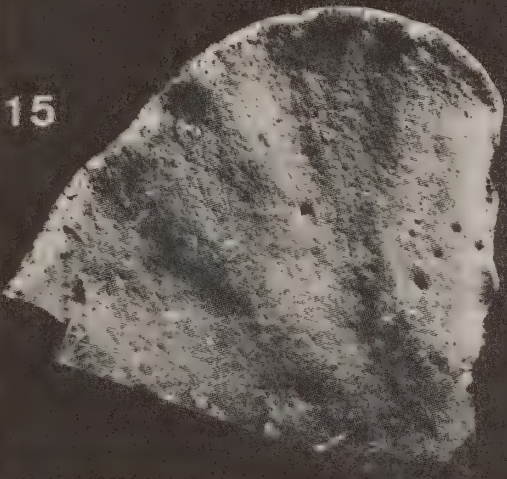
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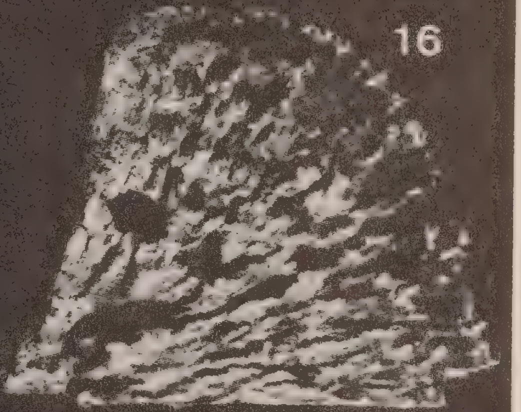
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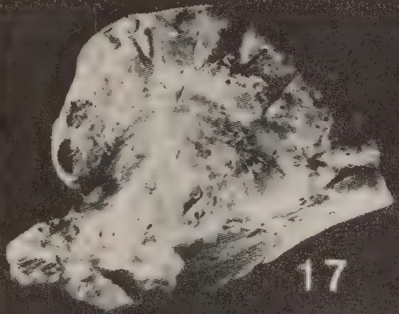
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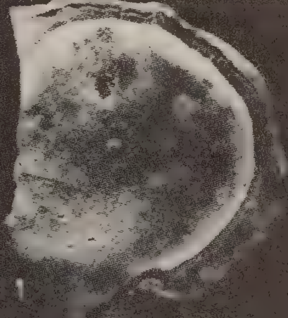
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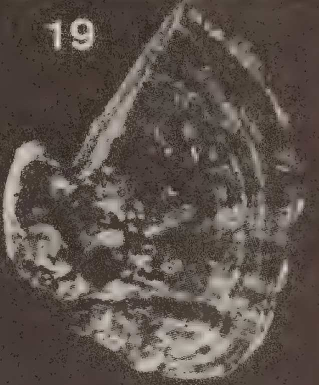
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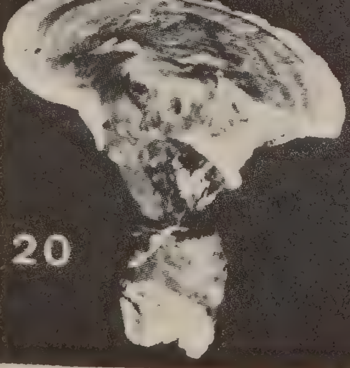
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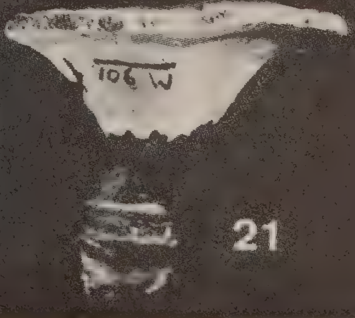

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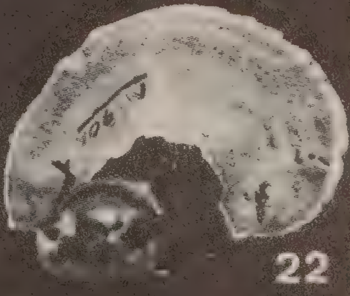

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brown, thick, endosporic pillars numerous, slender, not affectingthe perisporium; small, 6-9 x 4-6 µm. Hyphal system trimitic with clamped, thin-walled, hyaline generatives, with septa restricted to clamps, sparingly branched, 1-3 µm diam., abundant at the growth margin of the pileus, but also present in the context and dissepiments (Fig. 71). Skeletals aseptate, thick-walled, almost hyaline, solid to subsolid, arboriform at the end of branches, 3-8 µm diam., they form the bulk of the context and dissepiments (Fig. 68). Binding hyphae of the "Bovista" type, thinner than the skeletals, almost hyaline, thick-walled, aseptate, heavily branched, 1-3 µm diam., only present in the context (Figs. 69-70). Gasterospores abundant in the context, present in the dissepiments originating from vegetative hyphae, with dense contents and thick-walled, sometimes with 1-2 guttulae, almost spherical, completely smooth, 7-14 x 6-12 µm (Figs. 63-67).

Hosts: on dead fallen trunks of various species, on live *Platanus* (at considerable height on the trunk), and on stumps of *Pinus taeda*.

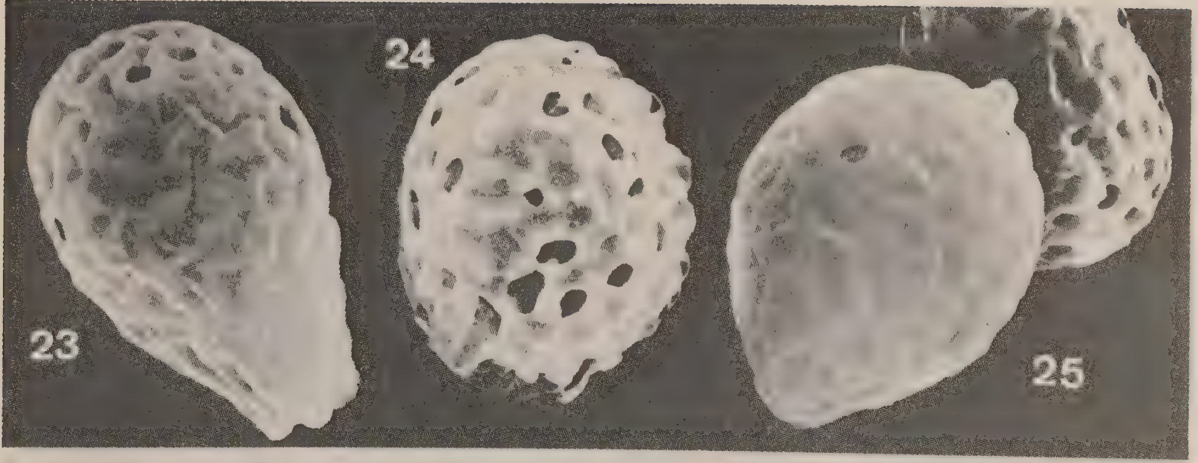
Distribution: Brazil, Argentina (Buenos Aires, Misiones).

Material studied: ARGENTINA: Buenos Aires: Tigre, leg. Connon, 15. V.1980. (HOLOTYPE, BAFC 25525). Misiones: Puerto Libertad, Alto Paraná plantation, leg. Deschamps, 21.XII.1979 (BAFC 24535); Parque Nacional Iguazú, leg. Bazzalo, 3.III.1980. (BAFC 25056). BRAZIL: Manaos, banks of Rio Tapajos,leg. Alves da Sousa, 9.X.1977 (BAFC 24429); ibid.,Parque Nacional Pedreiras, leg. ipse, 1977 (BAFC 25527).

The basidiomes have the external appearance of *G. lucidum s. str.* but the micromorphologic differences are striking: much smaller spores which are broadly ellipsoid, of the "smooth" type, light context and frequent gasterospores both in the context and dissepiments. The study of a part of the holotype (S) of *G. subamboinense* P. Henn. showed that it possessed gasterospores (not mentioned in the diagnosis), of the same size and shape but differing in being ornamented with veins anastomosing to form a sort of reticulum. Since our materials only differ from *G. subamboinense* var. *subamboinense* in the total lack of ornamentation of the gasterospores and a slight variation in the spore measurements which are 7-9 x 4-6,5 µm in the holotype mentioned, we believe this warrants the new variety proposed.

Furthermore, the specimens studied appear to be close to *G. multiplicatum* (Mont.) Pat. var. *vitalii* Steyaert (1962), which has also gasterospores but of a much larger size. We have been unable to secure the holotype of the latter.

Figs. 23-25: basidiospores of the "rugose" type of *Ganoderma lucidum s. str.* (BAFC 24425). 26-33: basidiospores of the "smooth" type of *G. resinaceum*. 26 and 28 from BAFC 24436; 27, 31-33: from BAFC 24431; 30: from the holotype of *G. sessile* (all 10000 x).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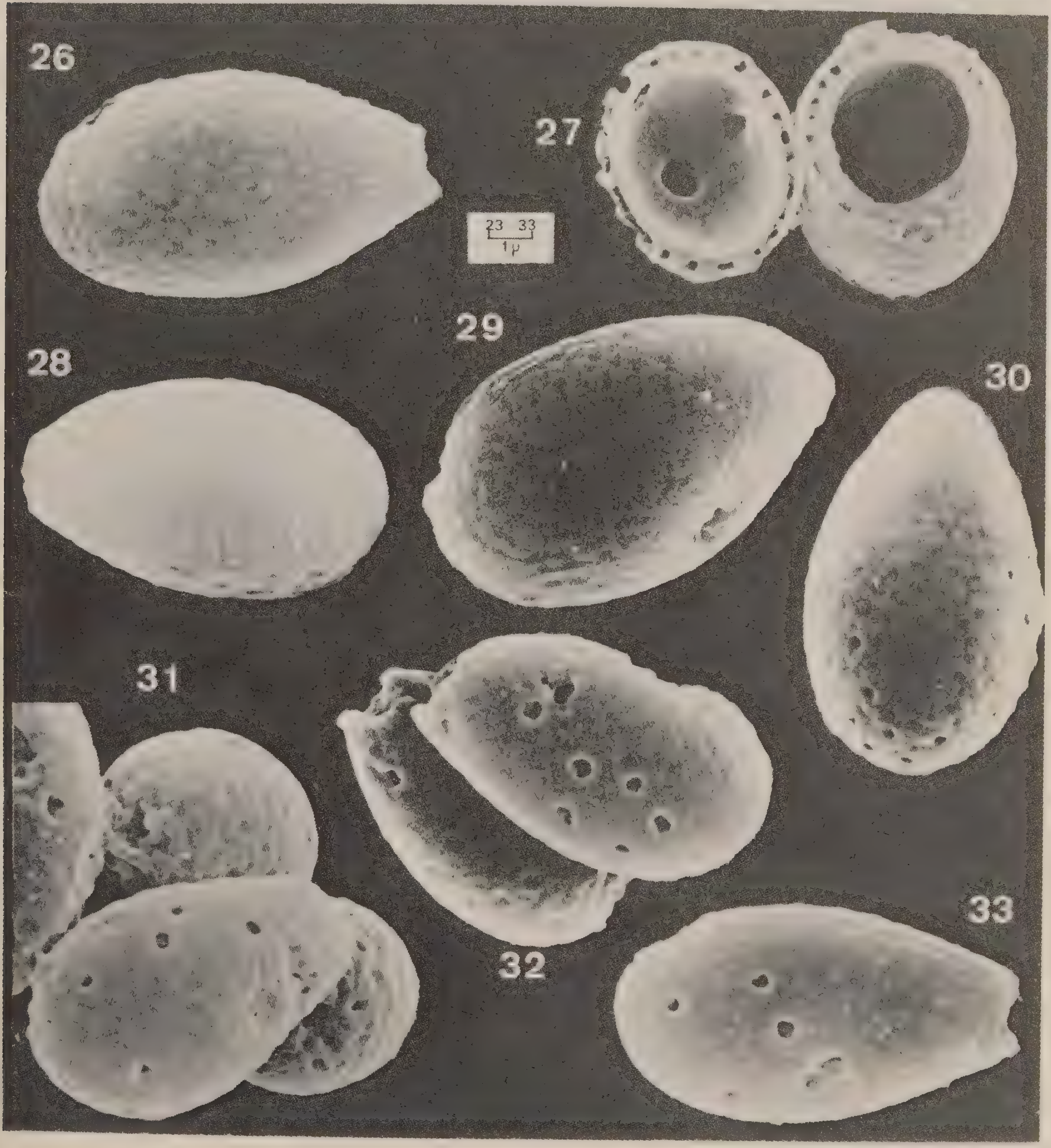
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Cultural features Figs. 72-82; 88-92; 94-101; 106.

Strains: BAFC n°247 = the HOLOTYPE (BAFC 25525). BAFC n°745 = Misiones: Parque Nacional Iguazú (see BAFC 25056).

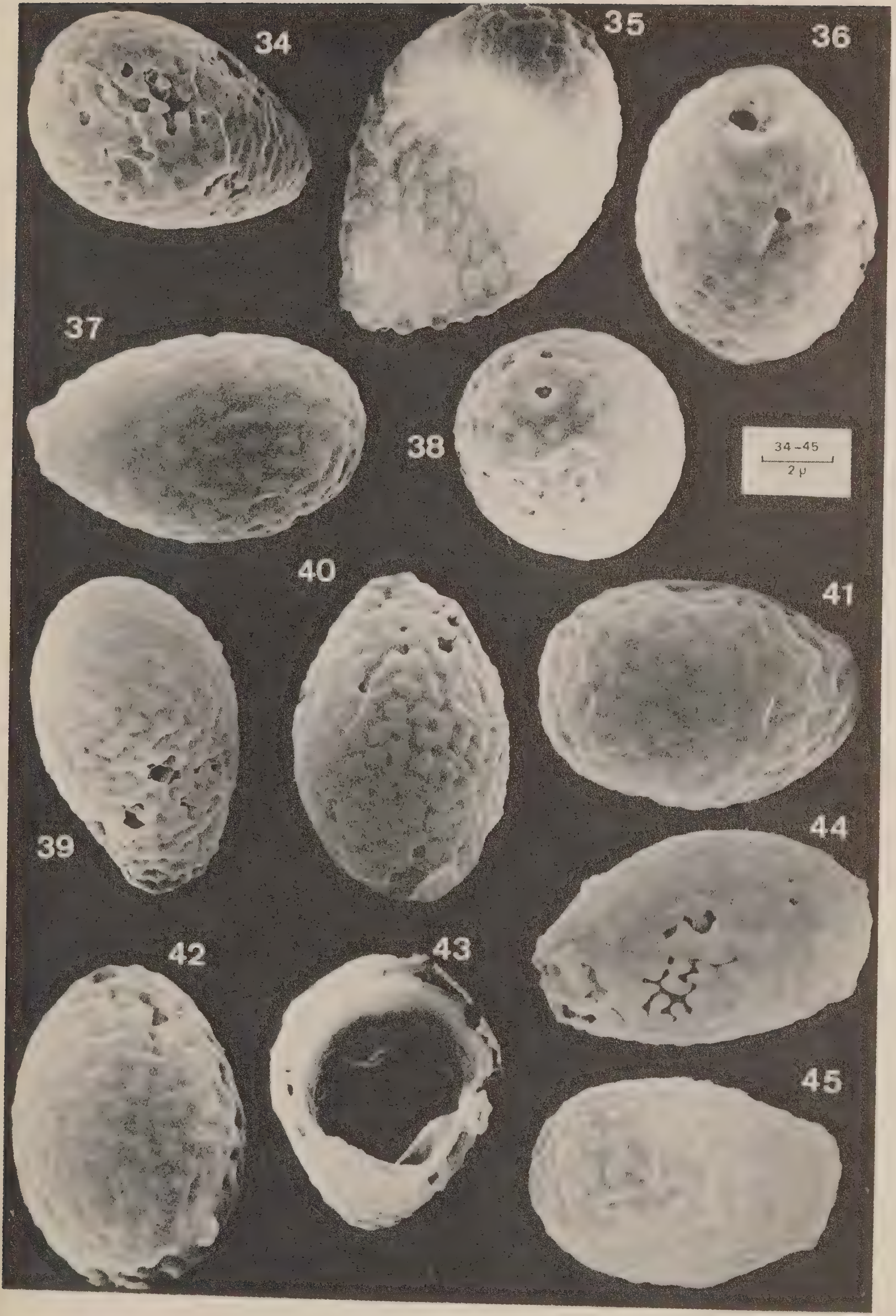
Code number: 2. 3. 8. 10. 34. 36. 37. 39. 42. 53. 55.

Microscopic characters: growth fast, reaching 3-4,5 cm diam. in the first week, covering the plates in 2 weeks; mycelial mat white (Pl. 1 A 1); during the 3rd week ochraceous yellowish zones begin appearing appressed to agar (Pl. 12 B 7), at first irregularly at inoculum or at the marginal area. Texture farinaceous during the 1st week at the inoculum, the rest felty, becoming after the 2nd week totally farinaceous (Fig. 106). Reverse only altered in the areas of coloured mycelium, becoming yellowish to brownish. Margin regular, smooth. Odour sweetish. Oxidase reaction: with tannic acid = ++++ with growth; with gallic acid =+++++ without growth; with gum guaic= +.

Microscopic features: Marginal mycelium: formed solely by generative hyphae during the 1st week, which are clamped, with scant branches, septa restricted to clamps (Figs. 88-90), 2,6 μm diam., staining with phloxine or remaining hyaline; during the 2nd week: i) appear clamped stag-horn hyphae that stain well with phloxine, of the same size as the former, and with very abundant and thin ramifications which are very characteristic, in general dichotomic, very intrincately branched (Fig. 92); ii) unclamped, fibrous, aseptate, hyaline, thick-walled slender hyphae, 1-2 μm diam., heavily branched (Figs. 77-78); iii) hyaline "cuticular cells", originating from globose branches of hyaline generatives (Figs. 72-74), attaining various shapes and sizes and arranged tightly into a "pseudoparenchyma"; iv) dextrinoid chlamydospores, terminal or intercalary, with a simple or double golden wall (Figs. 94-101), almost spherical to ellipsoid, with dense contents that stain deeply with phloxine, 11-18 x 9-15 μm. Inoculum: with same features as the white mycelium. Coloured mycelium: i) generatives as in i) above, scarce; ii) "cuticular" cells with a thick golden wall arranged in a pseudoparenchyma which becomes compact and is responsible for the colour observed, shape and size variable, each element ca. 9-47 μm diam. (Figs. 75-76); iii) thick-walled clamped hyphae with golden walls, unbranched or with terminal irregular branches and unclamped sclerotized hyphae with narrow portions at regular intervals, appearing as rosary beads, 2-6 μm diam. (Figs. 79-82); iv) fibrous hyphae as in ii) above, very abundant, 2-4 μm diam.; v) dextrinoid chlamydospores which may be terminal or intercalary, same as iv) above. Submerged mycelium formed by: 1) generative hyphae with thin wall, tortuous, much branched with short branches, staining with phloxine (Fig. 91), 2-5 μm diam.; 2) chlamydospores as above; 3) "Cuticular cells" as above. The submerged mycelium in the coloured zone have "cuticular cells" with thick, golden walls and sclerotized generative hyphae, 2-8 μm diam., as well as typical chlamydospores; generative hyphae are scant.

This species has apparently not been described in culture before.

Figs. 34-45. Basidiospores of the "semirugose" type of *Ganoderma oerstedii*. 34-35, 37-38: from BAFC 24441; 36, 41-42: from the holotype of *Ganoderma tuberculosum*; 39-40, 43-45: from BAFC 24410 (all 10000 x).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GANODERMA RESINACEUM (Boud.)Pat., Bull. Soc. Mycol. Fr. 5: 72. 1889.

=*G. chaffangeoni* Pat., ibid. 5: 74. 1889 (Fide Steyaert). = *F. resinaceus* (Boud.) Sacc., Syll. Fung. 9: 179. 1891. = *G. sessile* Murr., Bull. Torrey bot. Cl. 29: 604. 1902; North Amer. Fl. 9: 120. 1908 (NY!). = *G. polychromum* (Copel.) Murr., North Amer. Fl. 9: 119. 1908. = *G. pulverulentum* Murr., ibid. 9: 121. 1908 (NY!). = *G. praelongum* Murr., ibid. 9: 121. 1908 (NY!). = *G. subincrustatum* Murr., ibid. 9: 120. 1908 (NY!). = *G. argillaceum* Murr., ibid. 9: 122. 1908 (NY!). = *G. nitidum* Murr., ibid. 9: 123. 1908 (NY!). = *G. subperforatum* Atk., Bot. Gaz. 46: 337. 1908. = *G. platense* Speg., Bol. Acad. Nac. Cienc. Córdoba 28: 363. 1926 (LPS!).

Figs. 7-10; 26-33; 60.

Annual, lignicolous, generally dimidiate to reniform, sometimes circular, spathulate or ungulate; isolated or imbricate, sometimes several pilei laterally confluent with their pseudostipes free or fused into one; sessile, substipitate; 3,5-55 x 3-18 x 1-8 cm. Pileus surface applanate, concave or more or less infundibuliform, smooth, irregularly rugose, concentrically sulcate and radially rugose or strongly tuberculose, laccate, brilliant or dull, sometimes dull due to a thick deposit of spores. Central zone yellowish brown, very light in young specimens (Pl. 12 H 12), darkening with age from the centre towards the margin, with a broad cream coloured to yellowish marginal band (Pl. 9 E 4); in mature specimens there is no such gradation, the surface being dark reddish brown (Pl. 7 L 11) or light reddish brown, homogeneous (Figs. 8, 10). Margin sterile, thick, blunt, straight, incurved or recurved, yellowish cream in actively growing specimens, dark reddish brown in mature ones. Pseudostipes lateral or central, very short to long, slender to thick, black, laccate, brilliant, 4-7 cm long, 2-5 cm wide, sometimes rudimentary. Section thin to very thick, thickening towards the base, 1-4 cm at about half the radius. Context corky and soft or woody and hard; 2-5 cm thick, uniformly brown (Pl. 13 H 9), or with a thin darker band above the tubes. Hymenophore poroid, white to yellowish, becoming dark brown when old (Figs. 7, 9) with a layer of tubes often decurrent on the stem, 5-15 mm long, slightly lighter than the context; pores circular, large to medium sized, 2-5 per mm, 89-309 µm diam., dissepiments 27-267 µm wide. Hymenium composed only of basidia that are globose, soon collapsing, 7-14 x 8-20 µm, 4-spored (Fig. 60). Basidiospores of the "smooth" type, 9-13 x 5-8 µm, with a thick endosporium, light yellowish, ellipsoid, with numerous slender endosporic pillars that do not influence the perisporium, which is smooth and thin, thus appearing "smooth" when observed with the O. M. at 400 x (Figs. 26-33). Dermis of the "hymenodermis" type, composed of claviform elements with scant lumen and blunt ends, originating from skeletal hyphae and arranged as in a hymenium, 7-16 µm diam., dermis 13-43 µm thick (Fig. 62). Hyphal system trimitic, with clamped, thin-walled generatives, with septa restricted to clamps, 1-6 µm diam., sparsely branched, abundant at the growth margin of the pileus and dissepiments (Fig. 71). Skeletals of the "arboriform" type, clampless, aseptate, with a thick, golden wall, with few branches limited to the distal end, 3-8 µm diam., very long, forming the bulk of the context and dissepiments (Fig. 68). Binding hyphae of the "Bovista" type, clampless, aseptate, of limited growth, thick-walled, in general thinner and paler than the skeletals, much branched, 1-4 µm diam. (Figs. 69-70), only present in the context, as a rule very scarce.

Hosts: on dead trunks of *Tipuana tipu* (dead as a result of the fungal attack); *Quercus suber* and undetermined hardwoods; at the base of *Casuarina cunninghamiana, Platanus acerifolia, Ulmus procera, Acacia sp., Salix, Prosopis algarrobilla, Blepharocalyx tweedii* and *Robinia pseudoacacia*; also on stumps and roots of undetermined hardwoods. Domański et al. (1967) record it also on *Fagus* and *Alnus*, although rarely.

Distribution: SOUTH AMERICA: Argentina (Buenos Aires, Capital Federal, Córdoba, Corrientes, Misiones, Tucumán and Salta); Uruguay; Venezuela. NORTH AMERICA: U. S. (Connecticut to Missouri, Alabama, Louisiana). CENTRAL AMERICA: Cuba, Honduras, Jamaica. It has also been recorded from Euro-Asia and Africa (Central). It seems to have a world-wide distribution in temperate and tropical areas.

Holotype: *Fomes resinaceus Boud.* (PC!).

Material studied: ARGENTINA: Buenos Aires: Parque Pereyra Iraola, leg. Merlo, 15.IV.1969 (BAFC 24458); Llavallol, Santa Catalina, leg. Deschamps et al., 4.II.1973 (BAFC 24460); Castelar, leg. Quiroga, 1.V. 1979 (BAFC24450); San Fernando, leg. Doyle (BAFC 25532); Hway 2, km 100, leg. Wright & Deschamps, 24.IV.1971 (BAFC 25535);Martínez, leg. Wright, 21.II.1971 (BAFC 24461); San Miguel, Quinta Zemborain, leg. Campi, 22. IV.1944 (BAFC 25529);La Plata, leg. Spegazzini, 8.V.1909 (LPS 24880) Acassuso, leg. Soriano, 23.III.1949 (LPS 31293, sub *G. lucidum*); no locality, leg. Spegazzini, II-1918 (LPS 24868, sub *G. lorentzianum*);no data (LPS 24855). Capital Federal: Fac. Agronomía, leg. Maluh & Bargiela, 4-I-1979 (BAFC 24427); Golf Municipal, leg. Wright, 15.II.1968 (BAFC 24439); Villa Pueyrredon, leg. Romero, 16.II.1978 (BAFC 24440); Jardin Botánico, leg. Agullo, 27.IV.1978 (BAFC 24412); Jardín Zoológico, leg. Astort, 29.IV.1979 (BAFC 24445); leg. Deschamps & Rovetta, 16.III. 1972 (BAFC 24459). Córdoba: Alta Gracia, leg. Spegazzini, I.1925 (LPS 30989). Corrientes: 12 km NE of Curuzú Cuatiá, leg. Singer, 8.II.1964 (BAFC 24436); Entre Ríos: Concepción del Uruguay, La Salamanca, leg. Hawryszko, 16.XII.1961 (BAFC 24407); Colón, Parque Nac. El Palmar, La Calera, leg. Del Busto & Deschamps, 2.IV.1971 (BAFC 24430); Dept°Rosario del Tala, Palacio San José, leg. ipse, 9.IV.1971 (BAFC 24432); ibid., leg. Deschamps, 15.II.1972 (BAFC 25533); ibid, leg. ipse, 31.XII.1971 (BAFC 24434); Gualeguay, banks of Gualeguay River, leg. Wright, 27.I.

1951 (BAFC 24438); Salto Grande, leg. Deschamps, 31.XII.1971 (BAFC 24454); Gualeguaychú, Rincón de Lauda, leg. Tonni, 21.VII.1974 (BAFC 24457); ibid., Parque Unzué, leg. Deschamps, 25.XI.1978 (BAFC 25530); Arroyo Isletas, leg. Bettucci, 12.XII.1963 (BAFC 24431); no data (BAFC 24453). Misiones: Colonia Belgrano, leg. Gómez, II.1965 (BAFC 24420). Salta: Alemania, leg. Bettucci & Guerrero, 29.I.1965 (BAFC 24409), Tucumán: garden of Lillo Inst., leg. Wright, 27.II.1971 (BAFC 24411); San Javier, leg. Rosa Mato n°2186 (LPS 26190 ex MVM); no data (LPS 24866). CUBA: Prov. Santiago, Alto Cedro, leg. Earle & Murrill 536, 19/20.III.1905 (HOLOTYPE of *G. praelongum* Murr., NY); Prov. Habana: pr. Santiago de las Vegas, leg. Earle 658, 5.VII.1904 (HOLOTYPE of *G. argillaceum* Murr., NY). UNITED STATES: New York, Bedford Park, V-1902 (HOLOTYPE of *G. sessile* Murr., NY). BRITISH HONDURAS: Puerto Sierra, Rio Esperanza, leg. Wilson 607, 28.II.1903 (HOLOTYPE of *G. nitidum* Murr. NY). GRENADA: leg. Broadway, 4.XI.1905 (HOLOTYPE of *G. pulverulentum* Murr., NY). JAMAICA: Hope Gardens, leg. Earle 176, 26.X.1902 (HOLOTYPE of *G. subincrustatum* Murr., NY). URUGUAY: Dept°Canelones, Parque Nac. Carrasco, leg. García Zorrón, 16.V-1960 (MVHC 2473).

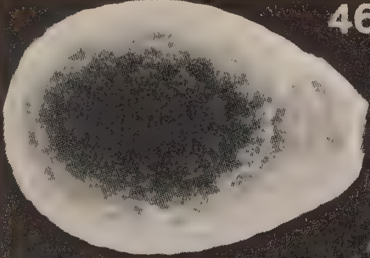
Steyaert (1972) studied the holotypes of *G. sessile*, *G. praelongum*, *G. argillaceum*, *G. resinaceum*, *G. polychromum*, *G. subperforatum* and *G. chaffangeonii*, and found that they all possessed identical micromorphological features, particularly the "smooth" type of spores, for which reason he considered them synonyms, the valid name of the species being *Ganoderma resinaceum* (Boud.) Pat. We have been able to study all the holotypes of Murrill's species deposited at NY and we agree with him, but found that to the above list must be added *G. nitidum* and *G. pulverulentum*, as well as *G. platense* Speg., the holotype of which was studied in detail (LPS).

The description of *G. subincrustatum* given in North American Flora by Murrill, does not agree with the holotype (Murrill, 1908: 122), since the spores are given as 8 x 4 µm, whereas our measurements are 9-11 x 6-8 µm. In the diagnosis of *G. nitidum* Murr., in the same paper, no mention is made of the spores; its holotype, according to our measurements, has spores measuring 9-13 x 5-7 µm.

Spegazzini (1926) reported from Argentina *G. lorentzianum* Kalchbr., including stemless, pleuropodal and centrally stipitate specimens, a concave, more or less infundibuliform pileus, and ovate, smooth to slightly ornamented spores measuring 10-12 x 5-7 µm; at first we believed they were mere forms of *G. resinaceum*, but a detailed study of them showed there were really significative differences between those specimebs and *G. resinaceum*. We do not know whether Spegazzini studied authentic materials of *G. lorentzianum* Kalchbr., and we were unable to locate the holotype in order to solve the

Figs. 46-50. Smooth type basidiospores of *Ganoderma subamboinense var. laevisporum* 46,49: from BAFC 24535; 47: from BAFC 25056; 48: from BAFC 25527; 50: from BAFC 25525. 51-56. Semirugose type of basidiospores of *G. zonatum*. 51-52: from the Holotype; 53,55: from BAFC 24416; 54: from BAFC 24449; 56: from BAFC 24414 (fig. 51, 9000 x; the rest are all 10000 x).

46



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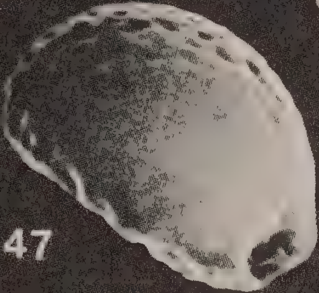

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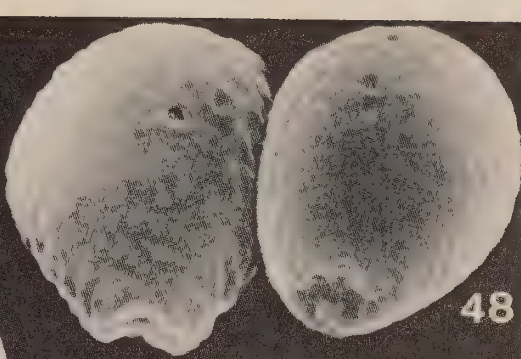

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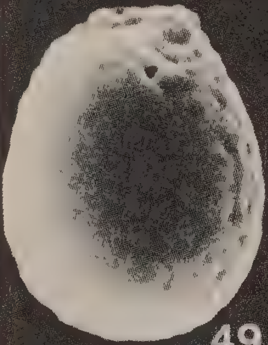

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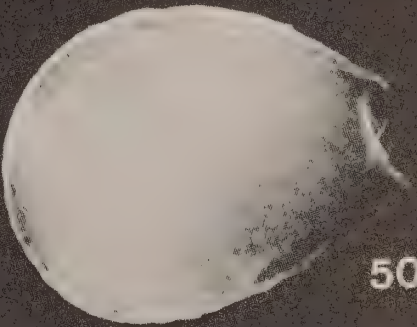
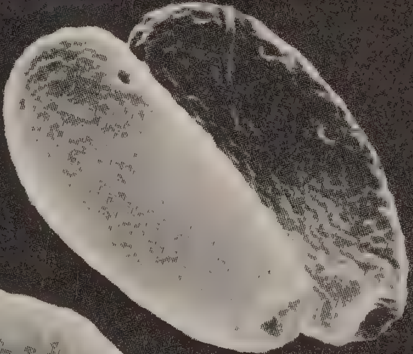


46-50,52-56
2 μ

51
2 μ

51



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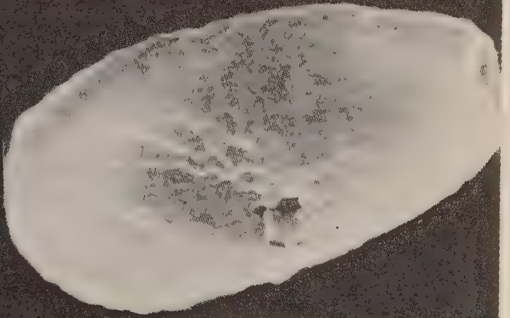

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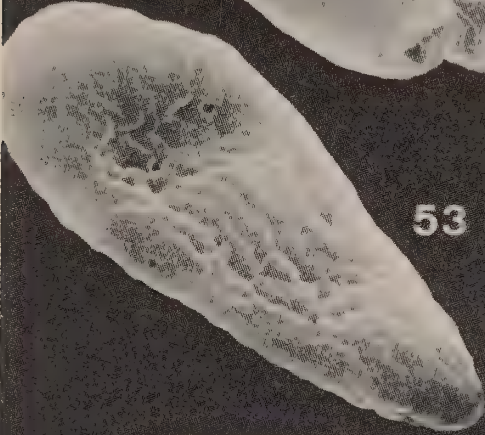

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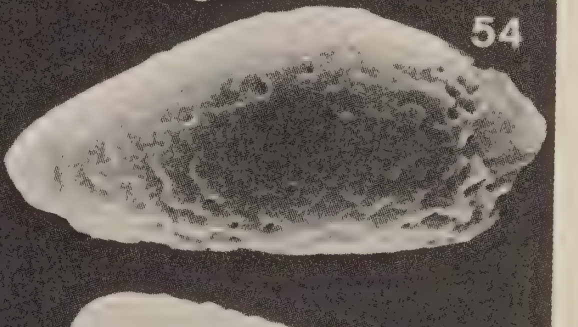

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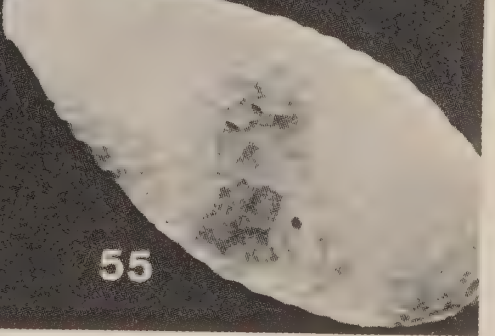

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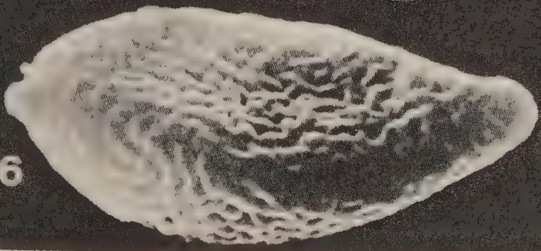


problem.On the other hand of two other specimens identified as *G. lorentzianum* by Spegazzini at LPS, one has "smooth" type of spores and the other "semirugose" type. Thus, the former must be included in *G. resinaceum* and the latter in *G. tuberculosum*.

The study of the holotype of *G. lorentzianum* Kalchbr. would be important to ellucidate the cospecificity of this species with *G. resinaceum*, since should they prove to be the same, *G. lorentzianum* would be the valid name.

Cultural features Figs. 75-78; 88-93; 96-103.

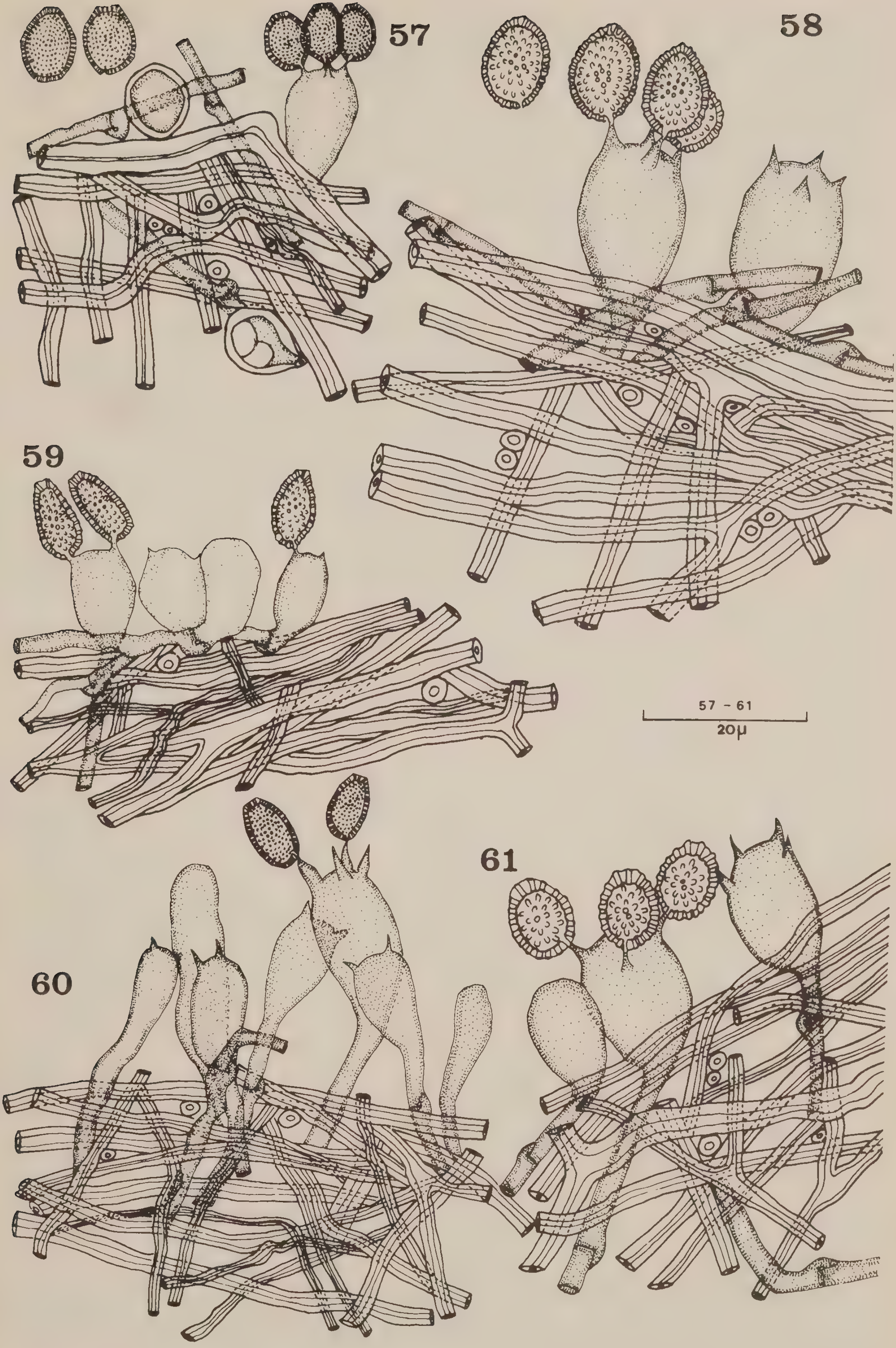
Strains: BAFC n°2221 = ARGENTINA: Buenos Aires, Llavallol (See BAFC 24460). BAFC n°2775 = Capital Federal, Villa Pueyrredon (see BAFC 24440). BAFC n°2354 = ibid. (see BAFC 24459). BAFC n°658 = ibid., Jardín Botánico (see BAFC 24412). BAFC n°2318 = ibid., calle Julian Alvarez y Aráoz. BAFC n°2813 = Entre Ríos, Arroyo Isletas (see BAFC 24431). BAFC n°228 = ibid., Dept°Rosario del Tala, Palacio San José (see BAFC 24432). BAFC n°2294 = ibid. (see 25533). BAFC n°443 = ibid., leg. Del Busto & Deschamps, 25.XI.1968. BAFC n°1009 = ibid., Gualeguay (see BAFC 24438). BAFC n°445 = ibid., Colón (see BAFC 24430). BAFC n°2576 = Tucuman: garden of the Lillo Inst. (see BAFC 24411). BAFC n°834 = CANADA, Ontario, Ottawa, 12.IX.1941 (DBFP 10222). BAFC n° 712 = ex NY 5191 sent by Dr. Robbins. BAFC n°716 = ex CBS 15222.

Code number: 2. 3. 8. (10). 34. 36. 37. 39. (42). (47). 54.

Macroscopic characters: growth moderately rapid, covering Petri dishes in 2-3 weeks. Mycelial mat transparent white at first, later remaining snow white with rather loose mycelium; in some cultures the inoculum becomes cream coloured with a few light yellowish zones appressed to the agar, irregularly distributed. Texture farinaceous during the first week at the inoculum, the rest subfelty, later the whole surface becoming farinaceous and the mycelium much denser (Fig. 102); in other cultures there is an alternation of dense, fan-shaped areas, with much less dense mycelium (Fig. 103), or zones that show alternation of dense and thin mycelium. Reverse: only altered in correspondence with zones of coloured mycelium, which becomes brown. Margin regular, smooth,with mycelium appressed to agar. Odour: slightly fungic to somewhat sweetish. Oxidase reaction: with tannic acid = ++++ with or without growth; with gallic acid = +++ or ++++ with or without growth; with gum guaiac = +.

Microscopic features: marginal mycelium: composed during the 1st week only of generatives, staining or not with phloxine, clamped, thin-walled with septa restricted to clamps, sparsely or not branched (Figs. 88-90), 2-6 µm diam. From the 1st to the 3rd weeks the following appear: i) "stag-horn" generatives, staining with phloxine, whose ends begin to branch out in numerous and very thin ramifications, mostly dichotomic, that become intertwined and form a dense reticulum (Fig. 92), 2-4 µm

Fig. 57 .Aspect of hymenium, basidiospores and gasterospores present in the dissepiments of *G. subamboinense var. laevisporum*. Fig. 58. Aspect of hymenium and basidiospores of *G. oerstedii*. Fig. 59. Aspect of hymenium and basidiospores of *G. zonatum*. Fig. 60. Aspect of hymenium and basidiospores of *G. resinaceum*. Fig. 61. Aspect of hymenium and basidiospores of *G. lucidum*. (All figures 1500 x).


57 - 61
20μ

diam;ii) chlamydospores both intercalary and terminal, abundant, the first originating from generatives, the latter from the ends of stained generatives; thick-walled, golden, with dense contents, ellipsoid, spherical or ovoid, dextrinoid, 9-22 x 7-18 µm (Figs. 96-101); iii) fibrous hyphae that are clampless, aseptate, thick-walled, hyaline or pale, not staining, heavily branched, in some cases forming the bulk of the mycelium, 1-4 µm diam (Fig. 77-78); from the 3rd to 4th weeks, there appear "cuticular cells", hyaline, originating from globose ramifications of generatives, of very irregular shape and size, 10-30 µm each, much appressed and forming a pseudoparenchyma that may become very compact (Fig. 93). Inoculum: same features as the marginal mycelium. Yellowish zones: formed by the same elements as the rest of the mat but the "cuticular cells" have a thickened golden wall (Figs.75-76); in a few cases sclerotized clamped hyphae appear, with thick, golden walls, but are not abundant. Submerged mycelium composed of tortuous generative hyphae with thin walls, that may stain or not, and have short but numerous projections, 1-5 µm diam. (Fig. 91). Also chlamydospores similar to those of the margin and a few "cuticular cells" may be found.

Observations: Culture BAFC n°2354 was the only one that fruited in the Petri dishes after the 5th week, in the form of an elevated mound in which a great density of fibrous hyphae concentrated; on them the pores were formed with fertile hymenium composed of globose basidia and basidiospores of the "smooth" type, 8-11 x 5-6 µm.

There exists a difference that allows the separation of the strains in two obvious groups, while the remaining features are similar in all cases, namely, the presence or absence of "cuticular" cells. Strains BAFC n°2372, 277, 113 and 1009 always formed these cells. The rest did not. The basidiomes corresponding to these cultures did not exhibit any differences.

The cultural characteristics of the strains studied coincide with those given by Nobles (1948), excepting the "cuticular cells" which may or may not be present, and the reverse that darkens but does not appear to become discoloured, as mentioned by her. Concerning this aspect, Stalpers (1978) states that it discolours locally and becomes locally coloured, with which observation we agree. Cultures from the CBS and NY identified as *G. resinaceum* were studied and they also did not show "cuticular cells".

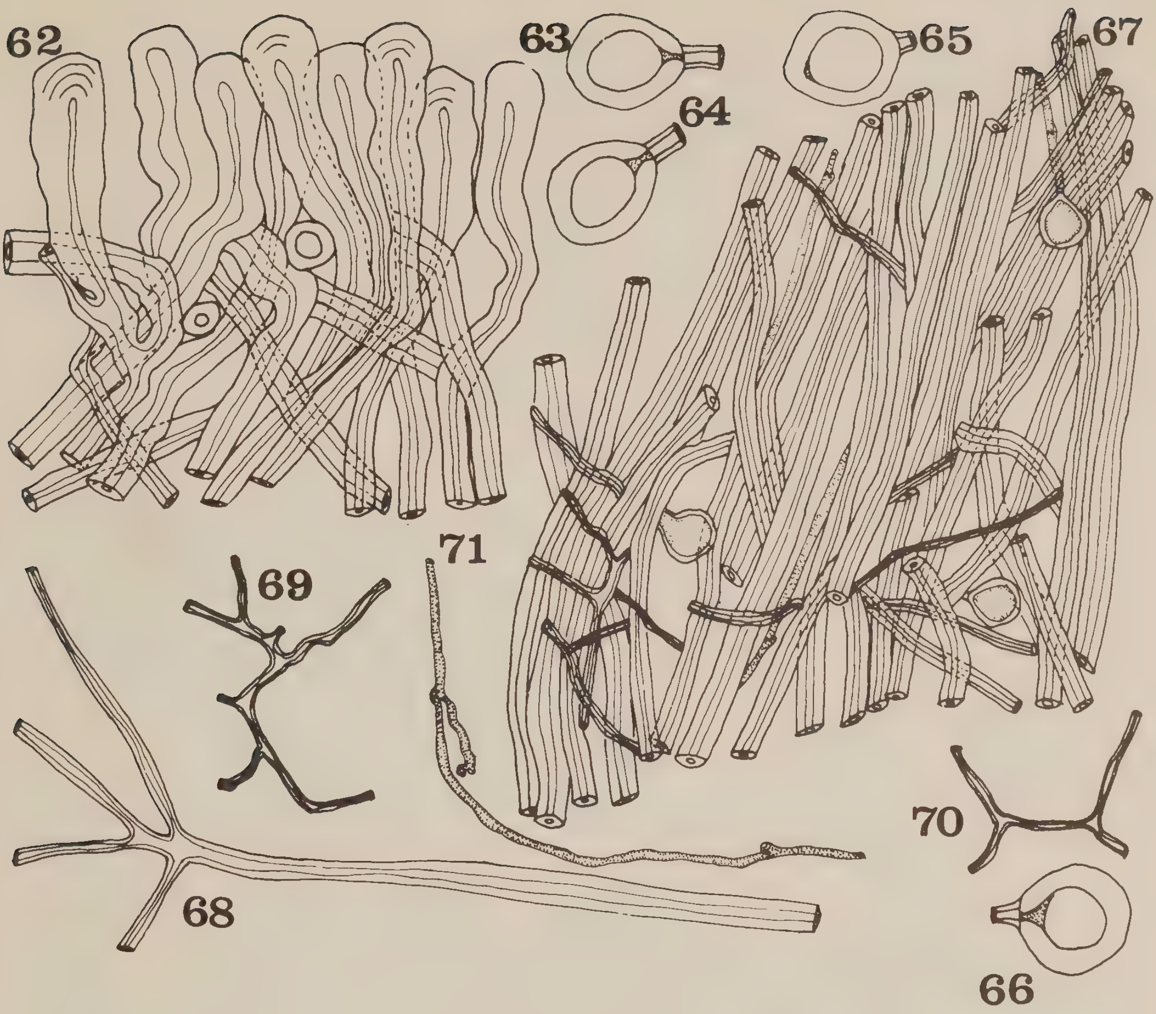
GANODERMA OERSTEDII (Fr.)Torrend, Broteria 17: 37. 1920.

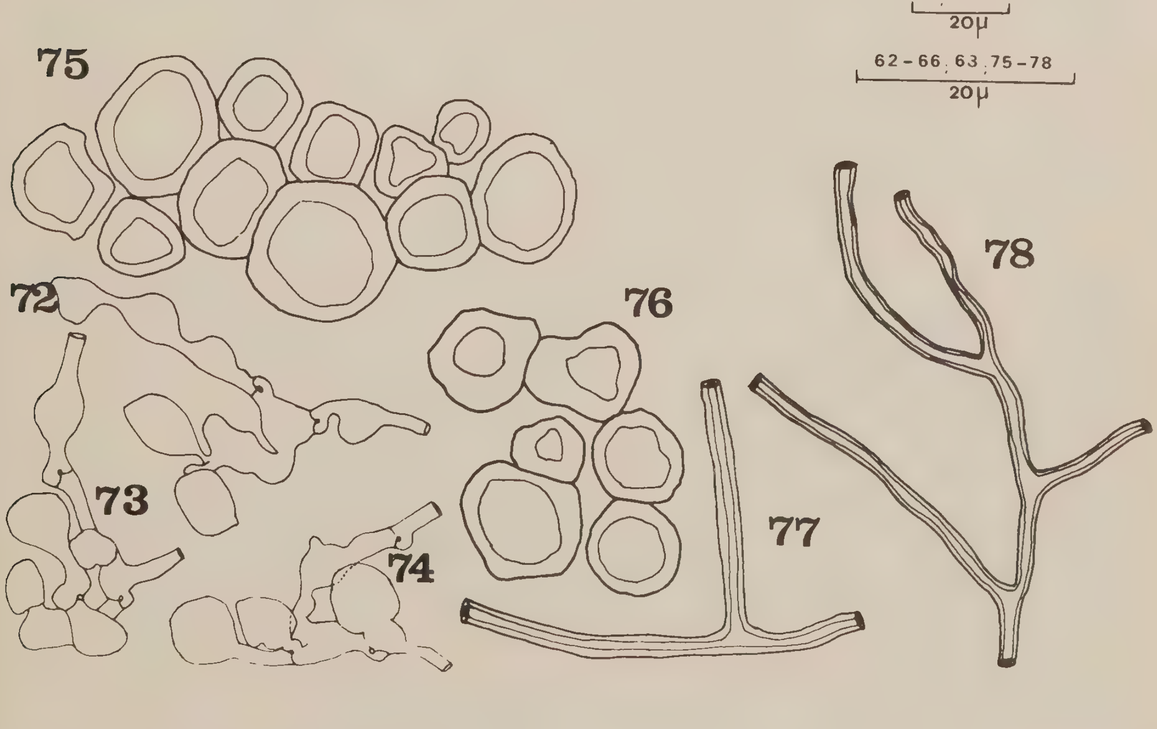
=*Fomes oerstedii* Fr., Nov. Symb. Myc. p. 63. 1855 (S!). = *G. tuberculosum* Murrill, North Amer. Fl. 9 (2): 123. 1908 (NY!).

Figs. 13-16; 34-45; 58.

Annual, lignicolous, dimidiate to reniform, isolated, cometimes imbricate, sessile or stipitate, small to large, 10-40 x 5-25 x 2-10 cm.

Figs. 62-71. *G. subamboinense var. laevisporum*. 62: hymenodermis; 63-66: gasterospores from the context and dissepiments; 67: aspect of context; 68: skeletal hyphae; 69-70: binding hyphae; 71: generative hyphae. Figs 72-78: cultural features (continued next page)

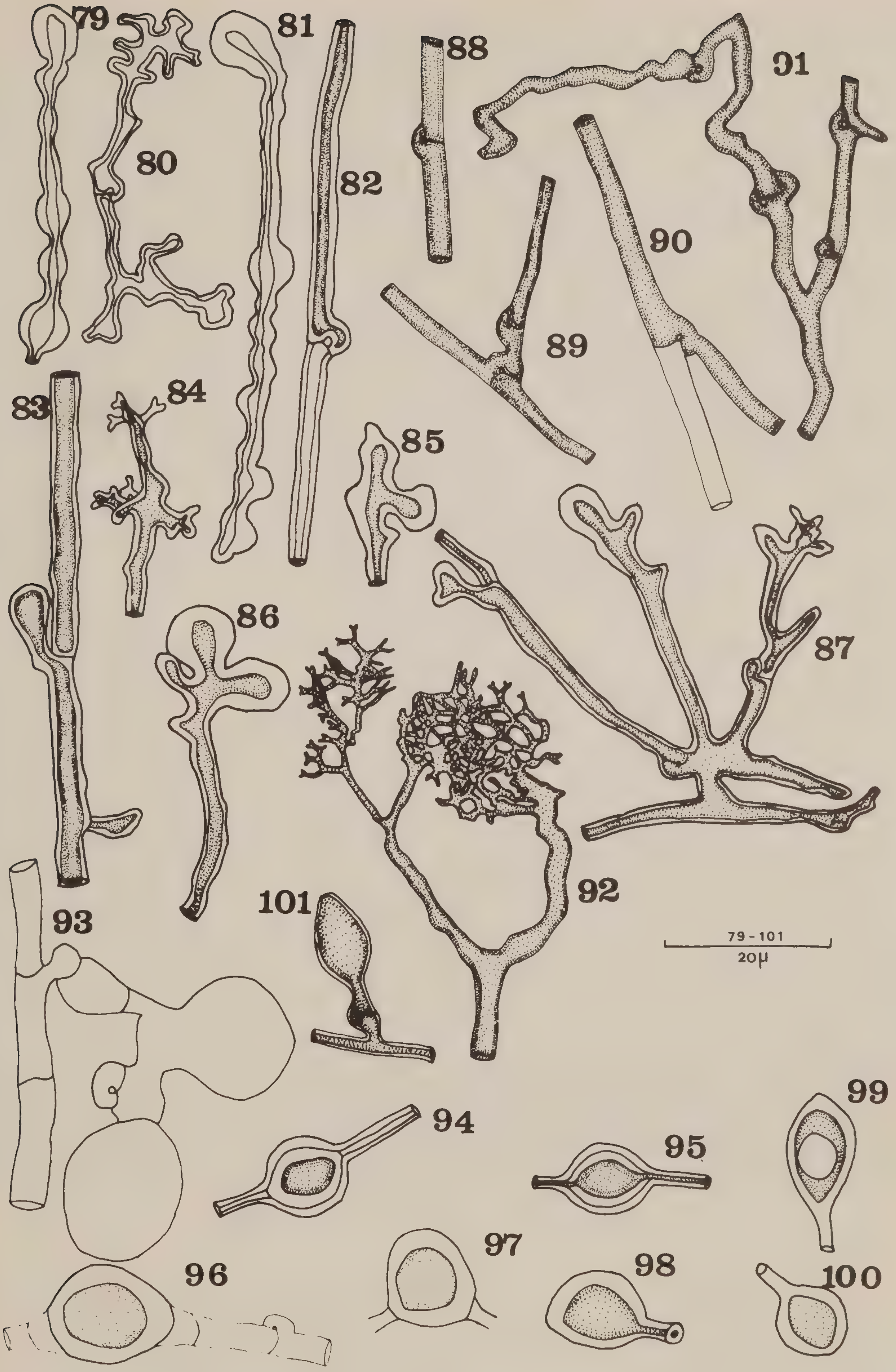



67, 69–74
20µ
62–66, 63, 75–78
20µ

Pileus surface radially rugose and concentrically sulcate or strongly tuberculate, frequently umbonate behind, laccate, brilliant,but mostly appearing somewhat opaque due to the deposition of a thick layer of brown spores (Figs. 14, 16); central zone dark reddish brown (Pl. 56 L 12), almost black, to light reddish brown (Pl. 6 L 12), much lighter towards the margin; generally the young specimens exhibit a wide creamish yellow marginal band (Pl. 9 E 4) that becomes homogeneous dark in mature ones. Margin sterile, thin to thick, acute to blunt, smooth or wavy, white to cream-colour (Pl. 9 B 1) in actively growing specimens, then straight, reddish brown in adult specimens, then incurved. Stem dark reddish brown, laccate, brilliant, thin and cylindric to thick and depressed, 5,5-9 cm long, 1,1-5 cm wide. Section thin to thick, 1,5-5 cm deep at about half the radius, thickening towards the base. Cutis thin, black brilliant. Context corky, brown (Pl 13 E 8), with a thin darker band over the tubes, or homogeneous dark brown (Pl. 7 C 11), up to 7 cm thick. Dermis of the "hymenodermis" type, composed of claviform tips of skeletal hyphae arranged like a hymenium, lumen small and blunt ends, 6-14 µm diam., 17-40 µm wide (Fig. 62). Hymenophore poroid, greyish white to yellowish (Pl. 9 J 5) darkening sometimes with age; pores small, circular to somewhat irregular, 4-6 per mm, 70-270 µm wide (Figs. 13, 15); tube layer slightly lighter than context, up to 3 cm thick; dissepiments 27-180 µm thick. Hymenium composed only of scant globose, 4-spored basidia, 9-16 x 9-10 µm (Fig. 58). Basidiospores of the "semirugose" type, brown in mass, broadly ellipsoid to almost ovoid (Figs. 34-45), with truncate apex, hyaline perisporium smooth and thin, endosporium thick, golden brown, with numerous endosporic pillars reaching the perisporium, rumpling it slightly and making it appear slightly rugose, 9-14 x 6-9 µm. Hyphal system trimitic with clamped, thin-walled generatives with septa restricted to clamps, unbranched, 2-4 µm diam., almost always restricted to dissepiments (Fig. 71).Skeletals of the "arboriform" type, clampless, aseptate, with a thick, golden wall,subsolid, with a

72-74: formation of "cuticular cells" from globose branches of generative hyaline hyphae; 75-76: thick-walled "cuticular cells"; 77-78: fibrous hyphae.

Figs. 79-93. Cultural features of *G. subamboinense var. laevisporum* and of *G. lucidum*. 79-82: sclerotized hyphae which are identical in both species, in 79 and 81 with thickenings that make them appear like rosary beads; in 80 only in the former species, with irregular branches and also unbranched. Figs. 83-87. *G. oerstedii*. Cultural features. Sclerotized hyphae with 83: short branches, 84: with numerous branches in all planes, 85-87: with claviform ends; 88-91: thin-walled generative hyphae, 88-90 from aerial mycelium; 91: from submerged mycelium; 92: "staghorn" hyphae; 93: formation of hyaline "cuticular cells". Figs. 94-101: chlamydospores. 94-95: double-walled chlamydospores of *G. subamboinense var laevisporum*. 96-97: simple-walled intercalary chlamydospores; 98-101: terminal ones (all figures 1500 x).


79 - 101
20μ

few restricted branches at the apical end (Fig. 68). Binding hyphae aseptate, unclamped, with limited growth, heavily branched, thick-walled, generally thinner and paler than skeletals, 1-4 µm diam., only present in the context (Figs. 69-70).

Hosts: on stumps of undetermined hardwoods, fallen trunks, dead *Quercus suber, Pinus spp., Ocotea acutifolia, Casuarina cunninghamiana, Spiraea cantoniensis, Scutia buxifolia* and *Lonchocarpus sp.*

Distribution: ARGENTINA (Buenos Aires, Córdoba, Corrientes, Entre Ríos, Misiones and Tucumán). Murrill (1915) records it on dead wood in British Honduras, Panamá and Western Jamaica; Dennis (1970) records it for Guyana.

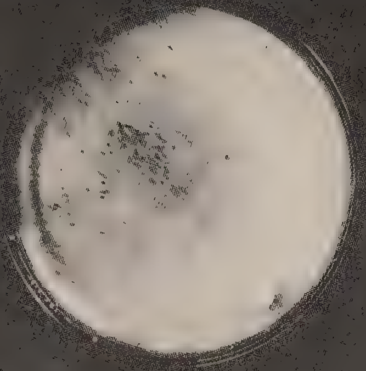
Material studied: ARGENTINA: Buenos Aires: Acassuso, leg. Sauval, 17.IV.1980 (BAFC 25528); Punta Lara, leg. Wright, 21.II.1971 (BAFC 24441 24423); Gral Alvear, leg. Di Riccio, 10.IV.1968 (BAFC 24410, 24411) . Córdoba: Salsipuedes, leg. Godeas, 5-III-1973 (BAFC 24442). Corrientes: Saladas, Paso Naranjito, marginal forest of Rio Santa Lucía, leg. Rovetta et al., 12.VII.1973 (BAFC 24413); Mburucuyá, Estancia Santa Teresa, leg. Wright et al., 16.VIII.1972 (BAFC 24424); Dept°Monte Caseros, Río Uruguay, Isla Itacumbú, E bank, leg. Irigoyen, 20.XII.1977 (CTES 438). Entre Ríos: Salto Grande, leg. Deschamps, 31.XII.1971 (BAFC 24426). Misiones: Parque Nacional Iguazú, Cataratas, leg. Wright et al.,25-X-1973 (BAFC 24437). Tucumán: no data (LPS 24866 as *G. lorentzianum*); no data (LPS 24869); no data (LPS 2497 as *G. orbiforme*). BRITISH HONDURAS: leg. M. Peck (HOLOTYPE of *G. tuberculosum* Murrill, NY). COSTA RICA: leg. Oersted (HOLOTYPE of *Fomes oerstedii* Fr., S; part at BPI).

Observations: Our materials coincide with the features of the holotype in everything except that their spores are somewhat more polymorphic, varying from ellipsoid to broadly ellipsoid. Some specimens resemble macromorhologically *G, resinaceum* (Boud.)Pat., but can be readily distinguished from this species by the basidisopores that are of the "smooth" type, and the number of pores per mm. This is the first record for Argentina. Steyaert (1980) places this species in his Section Characoderma on the basis of the thinner hyphae ending in a sphaeroid, which form the hymenodermis. We believe this feature is sufficiently variable to invalidate this proposal, precisely because in the present species such character, as Steyaert (loc. cit.) himself states, is intermediate in nature.

Cultural features Figs. 83-92; 104-105.

Strains: BAFC n°218 = ARGENTINA: Buenos Aires: Gral Alvear (see BAFC 24411). BAFC n°178 = ibid. (BAFC 24410). BAFC n°2249 = Córdoba:

Figs. 102-103. Cultural features of *G. resinaceum*. 102: strain BAFC n°2576; 103:strain BAFC n°113. Figs. 104-105. Cultural features of *G. oerstedii*. 104: strain BAFC n°218; 105: strain BAFC n°2249. Fig. 106: Cultural features of *G. subamboinense var. laevisporum*. Fig. 107: Cultural features of *G. lucidum s. str.* strain BAFC n°112 (all figures illustrate 3 week old cultures).



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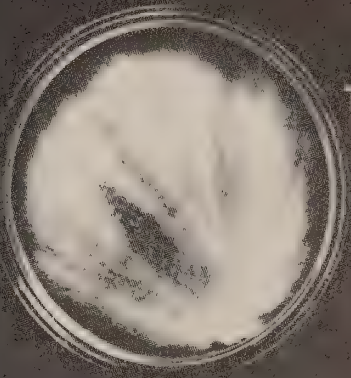

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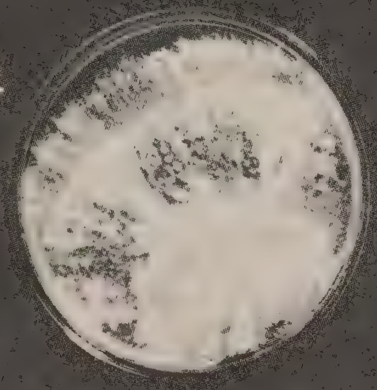

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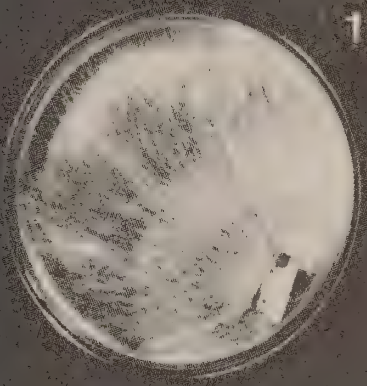

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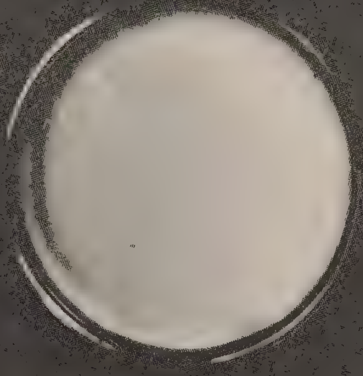

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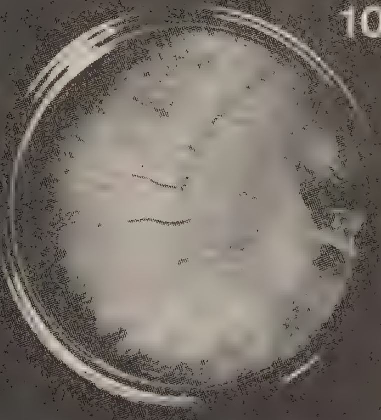

107

Salsipuedes (BAFC 24442). BAFC n°2382 = *Corrientes*: Saladas (BAFC 24413).

Code number: 2. 3. 8. 10. 32. (34). 36. 37. 39. 42. (43). 53. 54.55.

Macroscopic characters: growth rapid, covering Petri dishes in 2-3 weeks. Mycelial mat subfelty and white, at first transparent, later becoming totally farinaceous with yellowish zones (Pl. 13 K 5), irregularly arranged on the inoculum and the margin opposing it (Fig. 105),which may reach a large surface, or closely packed, felty at the inoculum, borders and discrete mounds irregularly scattered, somewhat elevated, later becoming confluent with ochraceous yellowish zones (Pl. 9 K 5), irregularly appearing on a dense mycelium (Fig. 104). Odour sweetish. Reverse altered in correspondence with the areas of coloured mycelium, becoming light to dark brown. Oxidase reaction: with tannic acid = ++++ with or without growth; with gallic acid = +++ with or without growth; with gum guaiac = +.

Microscopic features: Marginal mycelium during the 1st week composed mainly of generative, clamped hyphae with septa restricted to clamps, thin-walled, scarcely or not at all branched; in general, the branches originate at the clamps staining with phloxine, or hyaline, 1-4 µm diam. (Figs. 88-90); during the 1st or 2nd week, "stag-horn" hyphae appear, clamped, staining well, with dichotomically branched tips, developing numerous and very thin ramifications (less than 1 µm diam.), very intrincate and intertwined (Fig. 92); fibrous hyphae clampless, aseptate, hyaline, with a pallid thick-wall, heavily branched, 1-2 µm diam., these appear mostly the 2nd week, and when the margin becomes dense these constitute the bulk of the mycelium; otherwise they are not so numerous (Figs. 77-78); intercalary chlamydospores arising along clamped generativess, spherical to ellipsoid, with dense contents, 8-18 x 5-11 µm, very abundant or totally absent (Figs. 96-97). White farinaceous mycelium is composed of: i) generatives like those of margin, scarce; ii) "cuticular cells", hyaline, originating from globose ramifications of hyaline generatives (Figs. 72-74), very abundant, arranged in an appressed pseudoparenchyma, of various shapes, globose to very irregular; each element 4-30 µm diam.; iii) chlamydospores as those described above. Yellow farinaceous mycelium: with same elements as former, but the "cuticular cells" have golden, thick walls (Figs. 75-76); generatives with sclerotized golden walls are also present, which stain well with phloxine, and bear short branches, 1-4 µm diam.(Fig. 83). Zone of dense mycelium and elevated mounds: formed mainly by fibrous, abundant hyphae, with same features as those of margin; "cuticular cells" also present, mainly hyaline, as well as stag-horn hyphae. The zones of dense mycelium that become yellowish are formed by sclerotized clamped hyphae or not, sometimes very abundant, with a golden thick wall, scant lumen and claviform ends similar to the elements of the dermis of the basidiome, or numerous small branchlets branching in all planes, 2-9 µm diam. (Figs. 84-87). Submerged mycelium: formed by the same elements as the marginal, but generatives are more tortuous and possess numerous short branchlets (Fig. 91).

This species has not been described in culture before.

Numerous differences are observed between strains 178 and 218, and between strains 2383 and 2249. The first two exhibit a tight felty texture (Fig. 104) complete absence of chlamydospores, abundance of fibrous hyphae and less proportion of "cuticular cells"; the latter two present a farinaccoustexture (Fig. 105), presence of intercalary, dextrinoid chlamydospores, smaller proportion of fibrous hyphae, and compact pseudoparenchyma of abundant "cuticular cells". Coincident with these differences, the basidiomes from which strains 218 and 178 were obtained, have larger pores than the remaining specimens studied, the average being 4 pores per mm. Until further studies on interfertility can be carried out that could prove whether these differences are significant, it is preferable to maintain these materials as *G. oerstedii*.

GANODERMA ZONATUM Murrill, Bull. Torrey bot. cl. 29: 606. 1902; North Amer. Fl. 9 (2): 120. 1908.

= *G. sulcatum* Murr., ibid. 29: 607. 1902; North Amer. Fl. 9 (2): 120. 1908 (NY).

Figs. 17-22; 51-56; 59,

Annual, isolated, dimidiate and laterally stipitate, or several pilei imbricate on a common stem, 6-20 x 4,5-20 x 0,5-5 cm. Pileus surface smooth or concentrically sulcate, usually with 1-3 furrows, the inner one usually deeper, thus exhibiting a wavy appearance, sometimes also radially rugose; laccate, brilliant, central zone reddish brown (Pl. 7 I 11) becoming lighter towards the margin, with a narrow orange brownish marginal band (Pl. 12 D 11), often delimited by the external furrow and the margin (Figs. 17, 19-20). Margin sterile, blunt, straight, yellowish whitish (Pl. 11 B 1). Stem concolorous with pileus, laccate, brilliant, 3,5-5 cm long, 2-4 cm wide, vertical,cylindric or depressed. Section 8-10 mm deep at about half the radius, thicker at the base. Cutis thin, black, brilliant. Context brown (Pl. 14 C 12), slightly lighter at the surface of pileus, 3-44 mm thick, corky, soft. Dermis of the "hymenodermis"type, composed of the claviform ends of skeletal hyphae arranged in a palisade-like hymenium, 6-11 µm diam., with small lumina, blunt ends and thick, golden walls; dermis 17-33 µm thick (Fig. 62). Hymenophore poroid, tube layer 1-5,5 mm long, slightly lighter than context (Pl. 13 C 8), decurrent on stem, concolorous with margin, pores 3-5 per mm, 98-267 µm diam., circular to subangular, greyish to slightly brownish upon maturation (Figs. 18, 21-22); dissepiments 30-89 µm. Hymenium not persistent, composed only of scant basidia, 4-spored, 11-17 x 7-11 µm (Fig. 59). Basidiospores of the "semirugose" type, very characteristic, ellipsoid, long and slender, with truncate apex or, more frequently, rounded, 11-14 x 5-7 µm, perisporium hyaline, smooth and thin, endosporic pillars numerous, reaching the perisporium and slightly rumpling it, thus making it appear slightly rugose; endospore golden and thick (Figs. 51-56). Hyphal system trimitic, with hyaline, thin-walled, clamped generatives, with septa restricted to clamps, sparsely or not at all branched, 2-4 µm diam., present in the growth margin of pileus and dissepiments (Fig. 71). Skeletals of the "arboriform" type, long, with a thick, golden wall, clampless, aseptate, with 2-3 branches of same diam. as mother hyphae at distal end (Fig. 68), 3-6 µm diam., the most abundant in the context and dissepiments. Binding hyphae of the "Bovista" type, clampless, aseptate, of limited growth, heavily branched, generally thinner and lighter than skeletals, 1-3 µm diam., thick-walled, restricted to the context (Figs. 69-70).

Hosts: on dead stem of palm (*Butia yatay*) and dead wood and roots of living *Tipuana tipu*.

Distribution: U. S. (Florida, Georgia); ARGENTINA (Corrientes and Entre Ríos).

Material studied: ARGENTINA: Corrientes: Dept°Cosme, Paso de la Patria, leg. Singer, 5.IV.1957 (BAFC 24416); Mburucuyá, Estancia Santa Teresa, leg. Pedersen, 29.III.1977 (BAFC 24414). Entre Ríos: Parque Nacional El Palmar, leg. Mercuri, 25.II.1979 (BAFC 24449). UNITED STATES: Florida leg. Underwood, 1914 (HOLOTYPE , NY!); ibid., leg. Lloyd, I.1897 (HOLOTYPE of *G. sulcatum* Murr., NY!). CUBA: leg. Murrill (BAFC 25601, as *G. tuberculosum*).

It was not possible to obtain cultures of this species.

According to Murrill, the only differences between *G. zonatum* and *G. sulcatum* lie in the pileus surface. Both holotypes were studied in detail, their microscopic features being identical, especially the basidiospores, which are long, slender, ellipsoid, "semirugose" and of the same size. Pores are identical. All this coincides with the Argentine specimens(their spores being very slightly more rugose). We do not agree with Murrill's description in North American Flora, since our measurements of the spores from the holotypes are 11-14 x 5-7 µm and not 8-10 x 4-6 µm as he states, and the pores are 4-5 per mm and not 3-4.

We agree with Steyaert and Overholts that both species are synonyms. The former revised the holotypes in 1962 established their identity, and the latter published them as synonyms but as varieties of *P. lucidus* Leys.:Fr. under the epithet *P. lucidus var. zonatum* (Murr.)Overh. Only interfertility studies will be able to prove whether or not this taxon can be separated from *G. lucidum*. For the time being we prefer to consider it as separate.

DISCUSSION

According to our studies, the *G. lucidum*-complex would thus appear to be represented in Argentina by five species, namely, *G. lucidum s. str.*, *G. resinaceum* (Boud.)Pat., *G. zonatum* Murr., *G. oerstedii* (Fr.)Torrend, and *G. subamboinense* P. Henn. var. *laevisporum* var. nov. Spegazzini (1926) recorded other species for Argentina, which we have been unable to find in his herbarium, namely *G. cupreum*, *G. sceleton* and *G. fornicatum*. *G. platense* Speg., whose holotype was studied, resulted another synonym for *G. resinaceum*. Additional synonyms for this species proved to be *G. pulverulentum*, *G. nitidum* and *G. subincrustatum*. The question of the validity of *G. multiplicatum* var. *vitalii* Steyaert, *G. lorentzianum*

Kalchbr., and *G. orbiforme* Fr. remains pending a thorough study of their respective holotypes.

Since other holotypes and authentic materials of species that have as yet not been found in Argentina were studied, but were recorded from other South American countries, a preliminary general key for the complex has been included in this paper.

The type of dermis is useless for the separation of species, but permits the separation of "complexes" of species, such as in the present case. In this we agree with Steyaert (1972, 1980) and Imazeki (1939); they considered the existence of three or four (Steyaert, 1980) subgenera on this basis. Regarding the hyphal system of basidiome construction, our results confirm those obtained by Hansen (1958).

Cultural studies did not exhibit significative differences and ought to be used with caution. We attempted several methods for germinating spores with the hope of obtaining monosporous cultures in order to verify interfertility patterns, but were unsuccessful. This had been done previously by Merrill (1970) with similar results. We also tried the methods proposed by Aoshima (1953) and Brown (1970) for spores of *G. applanatum*,but also failed. We did not test Lim's method (1970). Equally unsuccessful were our attempts to obtain monokaryotic mycelia from dikaryotic ones (dedikaryotization). More studies in this line are urgently needed.

ACKNOWLEDGEMENTS

We wish to express our gratitude to the Instituto Forestal Nacional (IFONA), of Argentina, for granting Miss Bazzalo a fellowship for this study; to the Curators of the herbaria of the New York Botanical Garden, Jardin Botanique National de Belgique, Instituto "Carlos Spegazzini" and Instituto de Botánica del Nordeste (Corrientes) for the generous loan of holotypes and other specimens in their keeping; to Mr. Emilio Del Busto, in charge of the culture collection of the Mycology Laboratory, for his unflinching cooperation in our cultural work; to the SEM Service of the Consejo Nacional de Investigaciones Científicas y Técnicas, for the work on spore ornamentation, and to the many colleagues who have at different times and in different ways made this work possible. Special thanks are due to Dr. Leif Ryvarden (Oslo), Frances F. Lombard and Michael Larsen (Madison) for critically reading the typescript and making invaluable suggestions.

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NOTE.

After this paper was ready for the printer, two works related to a new species of the Ganoderma lucidum-complex from Europe came to our attention. Jahn, Kotlaba & Pouzar (Westfälische Pilzbriefe 9 (6): 97-124, 1979/1980) *described Ganoderma atkinsoni n. sp., very akin to G. lucidum, but differing by its rugose, wider spores measuring (9,8)-10,4-12,5 (-13,5) x (6,8)-7,3-7,8 (-8,5) um, often larger carpophores, the dark colour of the pileus and other substrates, mostly conifers. This species had been named G. pseudoboletus (= G. lucidum) forma montanum by Atkinson.* Kotlaba & Pouzar (Ceská Mycologie 35 (3): 121-133. 1981) *added further data on this species, which seems restricted to Central Europe and Great Britain.*

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TWO NEW SPECIES OF HELOTIALES FROM THE EASTERN HIMALAYAS

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During fungal forays undertaken by the senior author to the Eastern Himalayan regions of India and part of Bhutan, several interesting taxa belonging to the Helotiales have been collected. These include two new species belonging to the genera Bisporella Sacc. and Crocicreas Fr. emend. Carpenter, described and illustrated here.

Bisporella calycellinoides R. Sharma & Korf, **sp. nov.**

[FIGS. 1, 2]

Apothecia gregaria, parva, sessiles, cupuliformes, cremea ad brunneola, ad 1.5 mm diam., extus minute puberula, as basim annulo brunneo. Hymenium dilutum aurantiacum, in sicco cyathiformis, peraurantiacum. Asci octospori, poro iodo caerulescente, 58-65 x 6.5-7.5 µm, cylindracei-clavati, e uncis natis. Ascosporae hyalinae, biseriatae, guttulatae, guttulae polares, 9-11 x 2-3 µm, fusiformes, inaequilaterales. Paraphyses lanceolatae, septatae, leviter tumidae sub apice, ramosae, ad 6 µm latae, ascos superantes ad 18 µm. Excipulum ectalum ex textura intricata ad 36 µm latum, hyphae e cellulis parietibus incrassatis, cellulae plusminusve rectangularae. Excipulum medullatum ex textura intricata, ad 44 µm latum, hyphae hyalinae, cellulae leptodermaticae, ad 2 µm diam. – Holotypus: In foliis mortuis, Bhutan, Nawephu, Sept. 18, 1980; Raghunandan Sharma, PAN 17518. In herbario universitatis Panjab Cryptogamarum, Chandigarh.

Apothecia gregarious, small, sessile, cupulate, hymenium light orange, margin and external surface cream coloured, minutely downy, up to 1.5 mm diam, with a dark brown ring at the point of attachment, hymenium becoming deep orange, apothecia becoming more cupulate on drying. **Asci** 8-spored, J+, 58-65 x 6.5-7.5 µm, cylindric-clavate, base slightly swollen, apex round, arising from croziers. **Ascospores** hyaline, biguttulate, guttules polar, 9-11 x 2-3 µm, fusoid, inequilateral, biseriate. **Paraphyses** lanceolate, swollen a little below the apices, branched, septate, up to 6 µm broad, projecting up to 18 µm beyond the ascus tips. **Excipulum** differentiated into two zones: **ectal excipulum** up to 36 µm thick, of thick-walled, gelatinized, undulating hyphae, cells hyaline, 11 x 5.5 µm, somewhat rectangular; **medullary excipulum** of textura intricata, up to 44 µm thick, hyphae hyaline, thin-walled, up to 2 µm broad. **Hairs** formed when outermost cells are drawn out into small, smooth, 1-septate, hyaline hairs with obtuse tips, up to 18.5 x 3.5 µm, giving the apothecium its downy appearance. Hyaline hyphae near the base of the apothecium were up to 2 µm in diam, and observed to penetrate the host.

ETYMOLOGY: Refers to the calycellinoid ring at the base of the apothecia.

HABITAT: On dead angiosperm leaves.

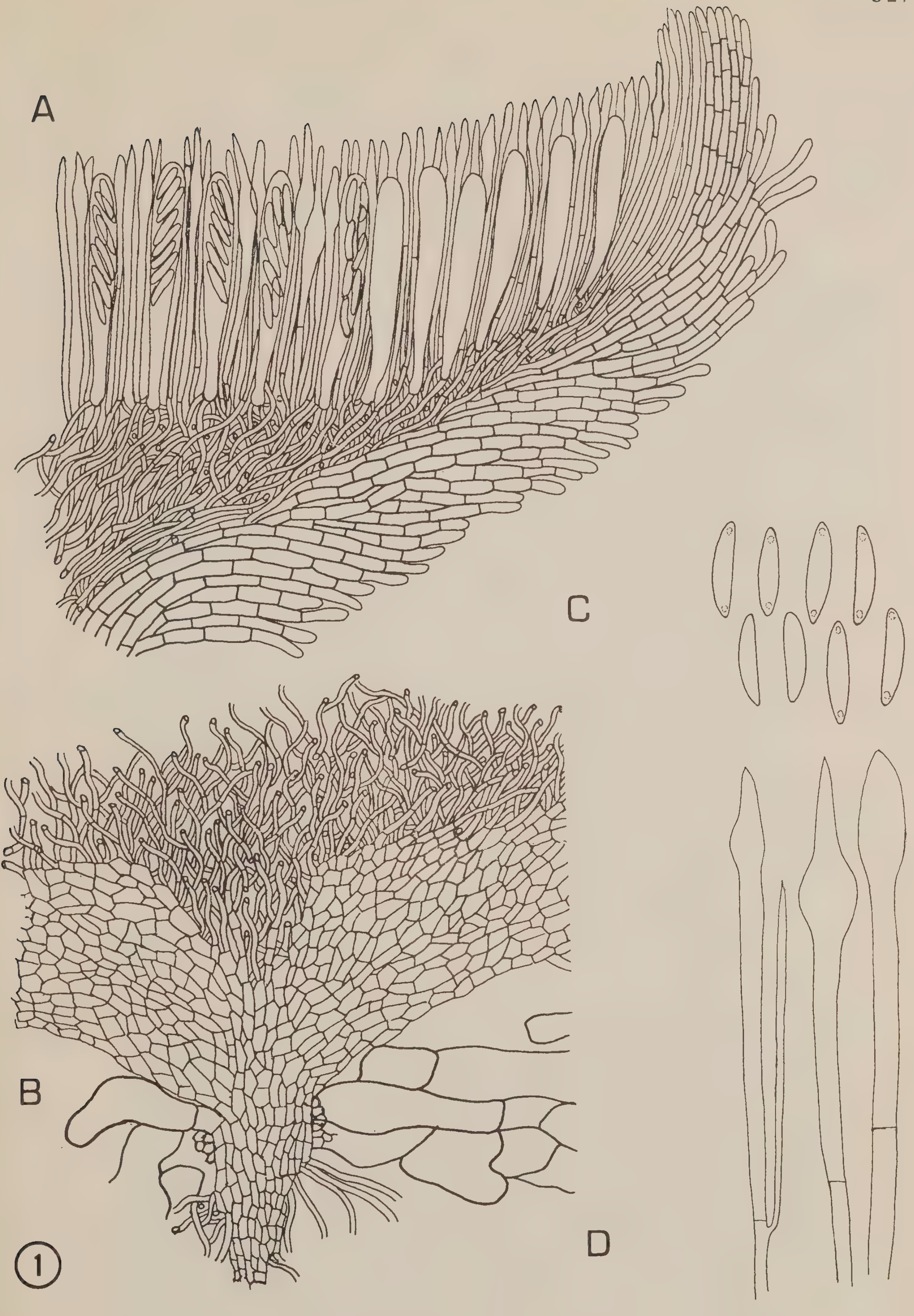


FIG. 1. **Bisporella calycellinoides.** A. Transverse section through margin. B. Transverse section through base of apothecium. C. 8 ascospores. D. 3 paraphysis apices. A, B: x 500; C, D: x 1000. (del. R. Sharma)

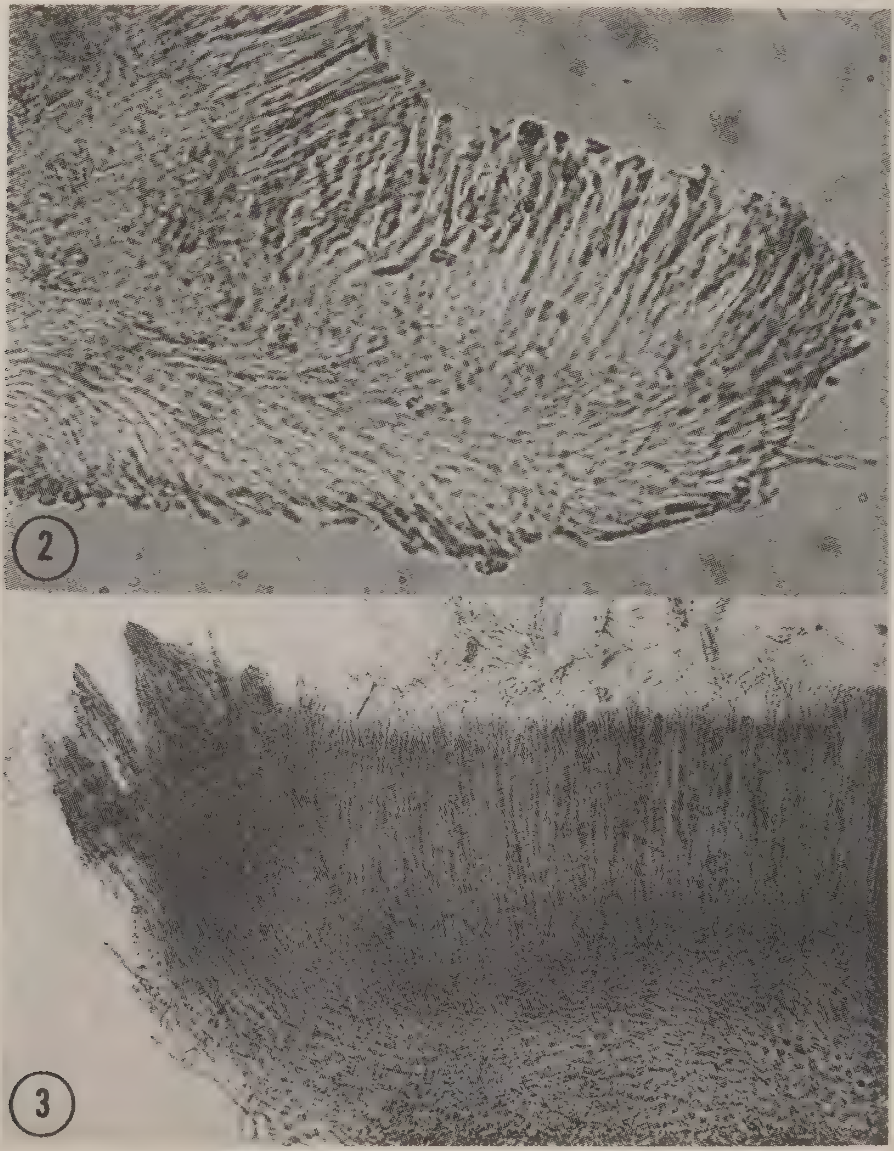
TYPE LOCALITY: Bhutan: Nawephu.

HOLOTYPE: PAN 17518, R. Sharma, September 18, 1980; ISOTYPE: CUP-IN 612.

NOTES: The undulating, thick-walled, gelatinized ectal tissues place this species in Bisporella. The habit on leaves, and the distinct brown basal ring immediately recall Calycellina, as does the yellow colour. In both genera hair-like processes are formed in some species.

Crocicreas carpenteri R. Sharma & Korf, **sp. nov.** [FIGS. 3, 4]

Apothecia sparsa, parva, sessiles, nigra, in sicco porphyrea, cupuliformes, ad 1 mm diam. Extus pilosus, pili saepe fasciculati, ad marginem formans dentes, cylindracei, contracti versus apicem, atrobrunnei, multiseptati (ad quatuordecimseptati), pachydermi, aspri granulis, ad 130 µm longi, cellulae ad 11.5-3.5 µm, parietes cellularum ad 2 µm crassi. Hymenium dilute brunneum. Asci octospori, poro jodo non caerulescente, 90-108 x 7.5-9 µm, apex rotundatis, incrassatus ad 2.0 µm. Ascosporae hyalinae, multiseptatae (at maturatim usque ad septemseptatae), 15.5-21 x 2.5-3.5



FIGS. 2, 3. Transverse sections through margins, x 500. FIG. 2. **Bisporella calycellinoides.** FIG. 3. **Crocicreas carpenteri.** (photos: R. Sharma)

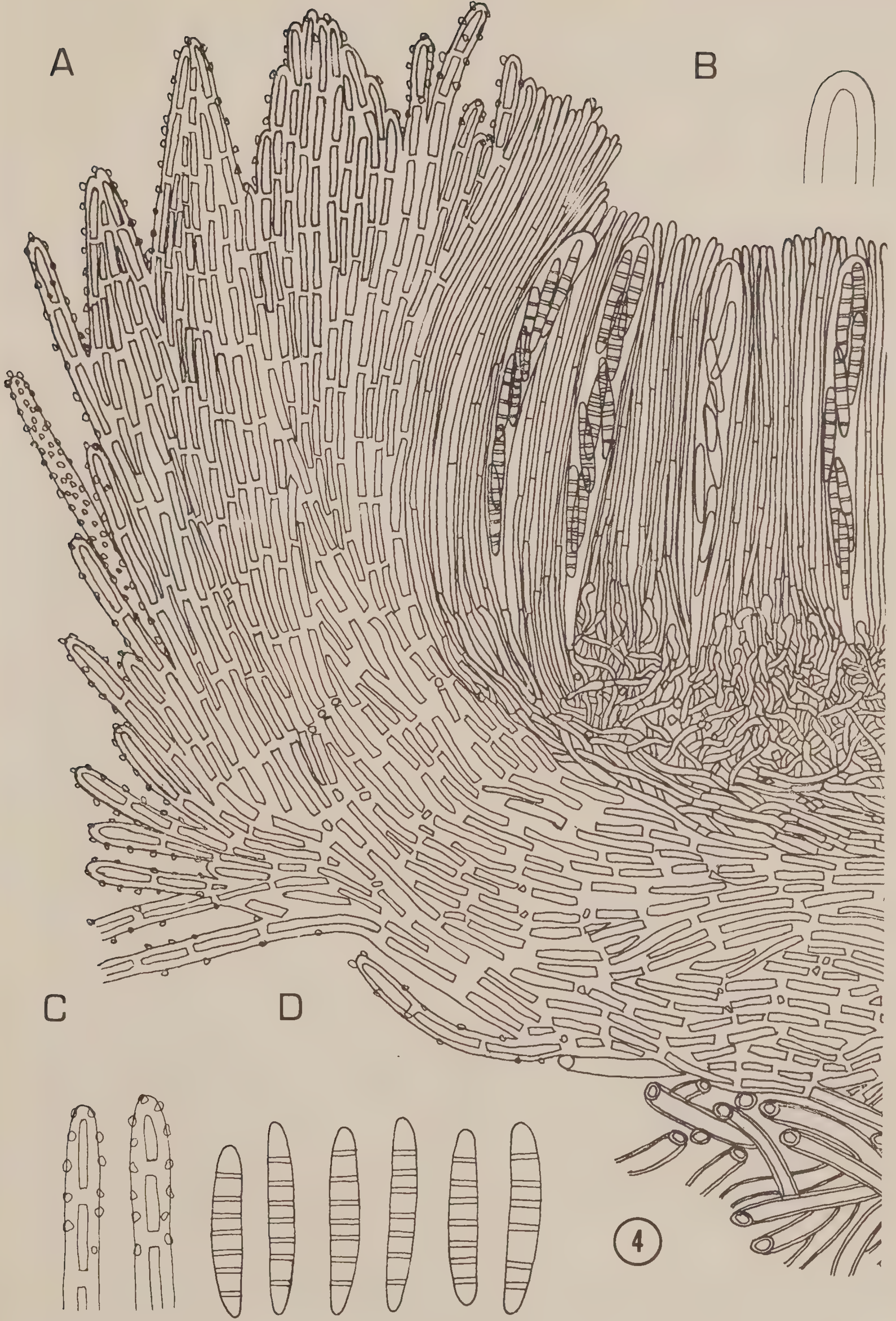


FIG. 4. **Crocicreas carpenteri.** A. Transverse section through margin. B. Ascus apex. C. Two apices of granulate hairs. D. 6 ascospores. A: x 500; B–D: x 1000. (del. R. Sharma)

µm, cylindraceae, rectae vel curvatae, biseriatae, in extremitatibus rotundae. Paraphyses filiformes, ramosae, septatae, usque ad 1 µm latae, ascos superantes ad 8 µm. Excipulum ectalum ex textura oblita, gelatinosum, cellulae hypharum pachydermae vitreaeque, usque ad 32 x 5.5 µm. Excipulum medullatum ex textura intricata, hyphae hyalinae leptodermeae usque ad 2 µm latae. - Holotypus: In ligno decorticato, Darjeeling (W. B.), Aug. 20, 1980; Raghunandan Sharma, PAN 17406. In herbario universitatis Panjab Cryptogamarum, Chandigarh.

Apothecia scattered, small, saucer shaped, hairy, margin strongly incurved, up to 1 mm diam, external surface black, the margin shining due to the granularly roughened apices of the hairs, hymenium light brown. **Hairs** cylindrical, tapering towards the apices, dark brown, granularly roughened, thick-walled, multiseptate, up to 14-septate and 130 µm long, cells up to 11.5 x 3.5 µm, wall of cell up to 2 µm thick, hairs often cemented together to form **teeth,** particularly at the margin. **Asci** J-, 8-spored, 90-108 x 7.5-9 µm, apex hemispherical, up to 2 µm thick. **Ascospores** hyaline, up to 7-septate at maturity, 15.5-21 x 2.5-3.5 µm, cylindrical, curved, with round ends, arranged more or less biseraitely. **Paraphyses** filiform, hyaline, branched, septate, up to 1 µm wide at the apices, not swollen, projecting up to 8 µm beyond the ascus tips. **Excipulum** differentiated into two zones: **ectal excipulum** of textura oblita, up to 84 µm thick, cells very thick-walled, up to 32 x 5.5 µm; **medullary excipulum** of textura intricata, up to 29 µm thick, hyphae hyaline, up to 2.0 µm wide.

ETYMOLOGY: In honour of S. E. Carpenter, monographer of the genus.

HABITAT: On decorticated angiosperm wood.

TYPE LOCALITY: India: 6th mile, Darjeeling (W. B.).

HOLOTYPE: PAN 17406, R. Sharma, August 20, 1980; ISOTYPE: CUP-IN 608.

NOTES: Though in some respects this species recalls Xylogramma Wallr., its affinities are surely in Crocicreas, though it is clearly distinct from any of the 54 taxa accepted by Carpenter (**1981**).

ACKNOWLEDGEMENTS

The senior author is thankful to Dr. W. R. Arendholz, Fachbereich Biologie, Universität Kaiserslautern, Kaiserslautern, West Germany for help with the Latin diagnoses. Financial assistance from the Department of Science and Technology (DST), India, is gratefully acknowledged.

REFERENCE CITED

CARPENTER, S. E. 1981. Monograph of Crocicreas (Ascomycetes, Helotiales, Leotiaceae). Mem. New York Bot. Gard. **33:** 1-290.

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REVUE DES LIVRES

par

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PREDOMINANTLY HOLOCARPIC AND EUCARPIC SIMPLE BIFLAGELLATE PHYCOMYCETES, by John S. KARLING, 252 p., 64 plates, Din, hard cover, 1981, J. Cramer, FL-9490 Vaduz, Lichtenstein.

This large size Cramer's edition is appropriate for the publication of the 64 ful-page plates of line drawings beautifully prepared by the author for the illustration of the 150 species described and which so much remind the high quality Thaxter's line drawings.

The species are classified in 7 families on the basis of thallus structure, developmental cycles and the methods of asexual and sexual reproduction. As the way of reproduction and of production of resting spores are unknown in many species, the limits of the genera are not sharply defined and their classification in coherent families is only tentative. Such classification is nowaday however provided as an aid in identification and a means of reference. The distinction between holocarpic and eucarpic organisms is not a clear cut and intermediate reproduction is found. The expression "predominantly holocarpic" is thus prefered. Two new species and one new combination are established. The 31 unnamed species however described demonstrate the state of constant progress in that field of taxonomy.

THE AGARIC GENERA LENTINUS, PANUS, AND PLEUROTUS, with particular reference to Malaysian species, by E.J.H. CORNER, in Beihefte zur Nova Hedwigia, part 69, 169 p., 2 pl., 40 fig., 8°, hard cover, 1981. J. Cramer, FL-9490 Vaduz, Lichtenstein.

Lentinus Fr. is redefined with skeleto-binding hyphae and relates with *Polyporus* sensu stricto. *Panus* Fr. is defined with long intercalary or terminal skeletal hyphae without binding hyphae. *Pleurotus* Fr. is either dimitic with tapering terminal skeletal hyphae without lateral branched binding hyphae and with thickened generative hyphae, or monomitic. *Panus* and *Pleurotus* relate with other polyporoid genera. Ten *Lentinus* species and one variety are described, 7 of which are Malaysian. Twenty species and 7 varieties are described in *Panus,* amongst them 12 species and the 7 varieties are Malaysian. *Pleurotus* includes 10 non Malaysian species and 23 species and 8 varieties from Malaysia. Many of these Malaysian taxa are new.

HIGHER TAXA OF BASIDIOMYCETES, by Walter JÜLICH, in Bibliotheca Mycologica n° 85, 485 p., 20 pl., 34 fig., 8°, hard cover, 1981. J. Cramer, FL 9490 Vaduz, Lichtenstein. Price: DM 120./150.-

The author proposes a new classification of the Basidiomycetes based on microscopical characters such as basidia, basidiospores and hyphal structure. He also emphasizes the phylogenetic relationships between members of traditional groups like Agaricales, Aphyllophorales and Gastermycetes in the Homobasidiomycetes. Interesting relationships are shown also in the Heterobasidiomycetes. In the Gasteromycetes, microscopical studies should also reveal more evidences of affinities. A general phylogenetic scheme is proposed in which the Cantharellales and the Auriculariales take the oldest position.

The class Homobasidiomycetes is subdivided in 12 unnamed groups of orders which are 49 all together. The Tricholomatales, the Entolomatales, the Amanitales and the Pluteales are segregated in the group 6 from the Agaricales (group 7). The Sclerodermatales, the Melanogastrales, the Leucogastrales and the Tulostomatales are with the Agaricales in group 7. The Russulales are grouped with the Bondarzewiales and the Hericiales in group 3. The author's hope is that the resulting classification is a more natural one.

In the special part of the book, characteristics and affinities of each family and higher taxon, many of which are new, are detailed and illustrated with line drawings and SEM spore photographs.

THE RESUPINATEN PHELLINUS-ARTEN IN MITTELEUROPA, mit Hinweisen auf die resupinaten Inonotus-Arten und Poria expansa (Desm.) (=Polyporus megaloporus Pers.), by H. JAHN, Bibliotheca Mycologica n° 81, 152 p., 21 fig., 61 phot., 8°, paper back, reprint 1981. J. Cramer, FL 9490 Vaduz, Lichtenstein.

The text consists of a paper reprinted from the Westfälische Pilzbriefe, 4(3-6):37-108, 1966-1967 followed by an original supplement, subtitled "Nachträge 1967-1981 (Fig. 13-21)" of 43 pages. In these papers the author demonstrates the anatomical differences between the two related genera *Phellinus* and *Innonotus*. He provides comments on the characteristics and the ecology of 16 *Phellinus* species and 5 *Inonotus* species. Keys are proposed for both genera. *Boletus expansum* Desm. (syn. *Polyporus megaloporus* Pers.) was renamed *Poria expansa* in 1967 and later *Donkiopora expansa* by Kotlaba and Pouzar; this species is also considered for its similarities to *Phellinus*.

STRUKTUR UND FUNKTION MITOCHONDRIALER DNA BEI PILZEN, by H.-U. KÜCK, in Bibliotheca Mycologica n° 84, 148 p., 19 fig., 8°, paper back, 1981, J. Cramer, FL-9490, Lichtenstein.

In this thesis, the author reports the isolation and characterization of the mitochondrial DNA from two fungi, a yeast, *Saccharomycopsis lipolytica*, and a filamentous ascomycete, *Podospora anserina*. In both species the mitochondrial DNA is a circular molecule with a GC contents (27.5 and 34.0 % respectively) lower than that of the nuclear DNA. The length of the molecule reaches 15.4 μm in *Saccharomycopsis lipolytica* and 32.8 μm in *Podospora anserina*. In the later species, the mtDNA is only recognized in a juvenile state but changes into a plasmid-like DNA of maximum circular length of 9.6 μm composed of monomere of 0.75 μm in length in the senescent state of growth. The author has been able to clone such plDNA in *Escherichia coli*.

THE BIOLOGY AND CULTIVATION OF EDIBLE MUSHROOMS, by S.T. CHANG and W.A. HAEYES, xxii + 819 p., 8°, hard cover, 1978. Academic Press, New York.

Since 1965, at the International Mushroom Congress in Amsterdam, the cultivation of mushrooms other than *Agaricus bisporus* started in Western Europe, while several species where already cultivated in the Eastern world, Japan and China, f.i. *Tricholoma matsutake*.

This book is the first comprehensive treatise available on the general biology and the culture technics of the different kinds of mushrooms now in cultivation. These are the fungi that grow on almost fresh plant residues (*Lentinus, Pleurotus, Flammulina, Auricularia, Pholiota, Tremella, Agrocybe, Ganoderma, Coprinus*), the fungi that grow on only little composted material (*Volvaria, Stropharia, Coprinus*), the fungi that grow on very well composted material (*Agaricus*), the fungi that grow on soil and humus (*Lepiota, Lepista, Morchella, Gyromitra)*and the mycorrhizal fungi (*Boletus, Cantharellus, Amanita, Tuber, Morchella, Lactarius,* matsutake). The book is general and specific. It bridges the gap between researchers and growers. It shows the problems and the progress in all aspects. Written by 32 contributors from eleven countries it deals with many different ways of mushroom cultivation. Nutritional value, medical effects and economical aspects of the increasing consumption of mushrooms are also considered.

MONOGRAPH OF THE PYTHIUM, by A.J. VAN DER PLAATS-NITERINK, in Studies in Mycology n° 21, 242 p., 103 fig., 8°, paper back, 1981. Centraalbureau voor Schimmelcultures, Baarn, The Netherlands. Hfl 70.-

This revision of *Pythium* Pringsheim is mainly based on living cultures preserved at the C.B.S. and a critical review of 1133 publications. 85 species are recognized and described alphabetically, 64 from living strains. In addition, two highly cellulolytic species are treated in an appendix. The species *P. buismaniae* and *P. macrosporon* are new. 65 remaining species are classified as uncompletely known, doubtful or to be excluded. The 87 accepted species and 13 uncompletely known species are keyed out dichotomously. Off those, 81 are homothallic, 9 are heterothallic, 1 species and 5 unnamed group-species have no oogonia but sporangia and 9 species have neither oogonia nor sporangia. In such a large and difficult genus, a synoptic key might have been helpful.

FUNGAL PHYSIOLOGY, by David H. GRIFFIN, xiv + 383 p., ill., 8°, hard cover, 1981. John Wiley & Sons, Wiley-Interscience, 605 Third Avenue, New York NY 10158.

The author has made a very needed synthesis of present knowledges on the physiology of the fungi. In such a field of steady progress, he provides us with a critical analysis of the different experimental approaches used by researchers. After chapters on the specific biochemistry and molecular architecture of the fungus cell, the author considers the primary and secondary metabolism. Chapter 5 to 8 deal with the growth, its rate and regulation, its chemical requirements, the transport and absorption of the nutrients and the response to the environmental factors. Chapter 9 to 12 deal with the reproduction: the effects of environmental factors on the spore formation (including circadian rythms), the biochemical and genetical regulation of the spore formation, the dormancy and germination of spores and the interesting aspects of syngamy, like the hormonal regulation in sexual interactions. Final chapters describe the behaviour of the fungi in natural attacks and provide a rational basis for the choice of fungicides. The text is precise and well documented by data and graphs from the literature. The author also points out the gaps in the present knowledge from a dynamic point of view.

CHAMPIGNONS DE SUISSE, Contribution à la connaissance de la flore fongique de suisse, TOME 1, LES ASCOMYCETES, Photographies en couleurs, descriptions et dessins d'observations microscopiques de 390 espèces de Suisse centrale et particulièrement du canton de Lucerne, by J. BREITENBACH and F. KRÄNZLIN, French translation by J. KELLER, 310 p., 390 fig., 390 col. phot., 4°, hard cover, 1981. Ed. Mykologia, CH-6000 Lucerne, Switzerland. SFr 118.-

This album is a modern and scientific account of the Ascomycetes from Central Switzerland, but common to all European countries. It is the first volume of a series prepared by the authors with the collaboration of members of the Société Mycologique de Lucerne. It results of a methodical and precise work procedure in collecting, describing, illustrating and preserving the fungi which will surely satisfy the scientist and traine the students. 384 Ascomycetes species are treated in a taxonomical order, within 37 families. Named by their Latin and French names, each species is described and illustrated from an accurately indicated collection which is deposited in herbarium. Macroscopical features are shown on a high quality color macrophotograph and microscopical structures exhibited in line drawings. The habitat of the species, taxonomical comments and pertinent literature are also given. The keys are di- or multichotomous and require the use of a microscope.

That book is a joy for the reader also for its design and color printing. It is an invaluable contribution towards the diffusion of a scientific knowledge of these fungi.

COMPENDIUM OF SOYBEAN DISEASES, by James B. SINCLAIR, Ed. 2d ed., 104 p., ill., 4°, paper back, 1982, The American Phytopathological Society, 3340 Pilot Knob Road, St Paul, Minnesota 55121. $ 11./12.

This second edition, revised with the aid of 76 world authorities in the field, has new sections including one on diseases caused by mycoplasmalike organisms, one on diseases of unknown origin and one on disease control strategies. The other sections have gained from more informations, references and illustrations. The 44 fungal diseases of soybean take a major importance in this Compendium.

AN ANNOTATED CHECK-LIST OF FUNGI CAUSING POSTHARVEST DISEASES OF FRUTS AND VEGETABLES IN ISRAEL, by Rivka BARKAI-GOLAN, Special Publication n°194, 36 p., paper back, 1981. Division of Scientific Publications, The Volcani Center, Bet Dagan, Israel.

This little paper provides with an alphabetical listing of the concerned fungi with indication of their host, the kind of symptoms, a brief account on the distribution and the importance of the decay.

MYCOTAXON

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NOTICE

INTERNATIONAL MYCOLOGICAL ASSOCIATION

RECORD OF THE BUSINESS MEETING HELD ON 26 AUGUST 1981 DURING THE XIII INTERNATIONAL BOTANICAL CONGRESS, SYDNEY

Agenda

1. President's remarks
2. Apologies for absence
3. Secretary's report
4. Treasurer's report
5. Committee reports
    (a) Nomenclature Secretariat
    (b) Asian Mycology
    (c) Latin American Mycology
6. IMA Statutes
7. Third International Mycological Congress
8. Structure of IUBS
9. Relationship with IUMS
10. XXI General Assembly of IUBS
11. Liaison office
12. Any other business

1. *President's remarks*

1. Professor C.V. Subramanian (President, IMA), welcomed members to the Business Meeting.

2. He first paid tribute to three outstanding mycologists who had passed away since IMC2, Professor Ralph Emerson, Professor F.K. Sparrow, and Dr Luella K. Weresub. Two minutes silence was observed by the whole Meeting.

3. Professor Subramanian welcomed the opportunity of mycologists participating in the Sydney Congress to meet together and the possibility of reporting on recent activities of the IMA to a wider audience than was usually possible.

4. He then proposed that the Agenda for the meeting, which had previously been circulated to affiliated organizations and members of the Executive Committee, be approved, and this was adopted by the Meeting.

2. *Apologies for absence*

5. Apologies for absence were received from three members of the Executive Committee, Dr J.A. von Arx (Treasurer, IMA), Professor J. Webster, and Dr G.C.A. van der Westhuizen.

3. *Secretary's Report*

6. Dr D.L. Hawksworth (Secretary, IMA) reported that since the IMA officers and Executive were elected at IMC2 in 1977, Professor R.A. Emerson (USA) passed away, and was replaced on the Executive by Professor A. Skirgiello (Poland). There have been a number of changes of addresses and a current list of the members of the Executive, which will serve until IMC3 in 1983, was tabled.

7. In 1978 the Executive considered submissions from the Mycological Society of Japan and the Mycological Society of India to host IMC3 and agreed that Tokyo was the most suitable centre. I would like to record the gratitude of the IMA to both Societies for their invitations. 1983 was selected as a date so that there would be a full year between the present Congress and IMC3. Precise dates were fixed to avoid a direct clash with the ISPP Congress in Australia the same year.

8. Copies of the Resolutions from IMC2 were circulated to national and international bodies, published in the *IUBS Newsletter*, and endorsed by the XX General Assembly of IUBS in Helsinki in 1979.

9. Professor Subramanian and Dr Hawksworth attended the XX General Assembl of the International Union of Biological Sciences (IUBS) to present a case on behalf of the Executive Committee for the recognition of an increased status for mycology within IUBS. As a result of discussions held in Helsinki, it was agreed to re-name the Division of Botany as the Division of Botany and Mycology, and further to create a Section of General Mycology, based on IMA, to replace the former Commission on Mycology. Professor Subramanian was also elected to the IUBS Executive as one of the representatives of the new Division at the Congress. The changes made at Helsinki pave the road for a strengthening of the voice of mycology in world biology.

10. Since IMC2, the Australian Plant Pathology Society, the International Association for Lichenology, the Society for Human and Animal Mycology, and the Societas Mycologica Fennica have all become affiliated to the IMA. A mutual affiliation with the International Association. for Plant Pathology has also been agreed in principle.

4. *Treasurer's Report*

11. Dr J.A. von Arx (Treasurer, IMA) had provided a statement of the current financial position for the information of the Meeting which showed a current balance of Hfl 27 572 at 1 July 1981.

5. *Committee Reports*

(a) Nomenclature Secretariat

12. Professor R.P. Korf (Member, Nomenclatural Secretariat), read a Report of the activities of the Secretariat to the Meeting.

13. The formal proposals for improvement of the treatment of fungi in the International Code of Botanical Nomenclature prepared by the IMA Nomenclature Secretariat, following reports of its Committees and debates at IMC2, were published by the Chairman of the Committee, Dr K.T. van Warmelo in *Taxon 28*: 424-431 (1978).

14. These proposals were considered by the Nomenclature Sessions prior to the Congress. It was unanimously accepted that the starting point date for all fungi would be changed from 1801 or 1821 to 1753 (with special provisions for names in the formerly cited "starting-point books"). The completely revised version of the Rules governing the names of fungi with pleomorphic life cycles was also accepted. Proposals to introduce living types into the Code failed, but one of the IMA's Recommendations was adopted and the Session recognized the problem. There was an impression that fresh proposals would be viewed sympathetically.

15. It had further been agreed in the Nomenclature Sessions of the Congress that three posts in the Special Committee for Fungi should be left vacant until IMC3. At IMC3 it may be proposed that this enlarged Special Committee should act as the Nomenclature Secretariat and appoint committees as required. Such a move might well eliminate the need for the present dual structure for considering problems of mycological nomenclature.

16. With regard to the question of the acceptance of living cultures as types, the present Meeting *recommended* that the Special Committee and Nomenclature Secretariat should cooperate with algologists in formulating fresh proposals.

(b) *Asian Mycology*

17. Professor Subramanian reported that he hoped to arrange a discussion meeting for Asian mycologists during 1982.

(c) *Latin American Mycology*

18. No report of recent activities was received.

6. *IMA Statutes*

19. The Meeting considered the draft Statutes of the IMA which had been drawn up following IMC1 in 1971, but had not been formally adopted by a subsequent International Mycological Congress.

20. The present structure had meant information too rarely percolated to individual mycologists, and there was a strong feeling, especially amongst Australian participants, that some form of individual membership should be retained even in countries that had national affiliated organizations.

21. The Executive Committee was instructed to take note of the views expressed and the Secretary agreed to prepare a revised set of Statutes for their consideration. Participants undertook to send any further comment they wished to be considered to the Secretary by 1 November 1981.

7. *Third International Mycological Congress*

22. The Meeting welcomed Professor K. Tubaki (Secretary-General, IMC3), who outlined the arrangements being made by the Japanese Organizing Committee. Professor N. Hiratsuka had been elected President, and Dr K. Iwata Vice-President of the Committee. The congress would be based on the Keio Plaza Hotel (Shin-juku, Tokyo) but it was expected

that most participants would stay in an adjacent business-class hotel. The First Circular had now been printed and copies were distributed to the Meeting. The Circular included a list of major topics to be included in the programme. A registration fee of about US $ 150 was anticipated. The Organizing Committee looked forward to the visit of the Secretary of the IMA to Japan following the Sydney Congress.

23. Professor T. Ahti (President, International Association for Lichenology), hoped that a lichenologist would be included in the Organizing Committee.

8. *Structure of IUBS*

24. Professor K. Esser outlined the discussions on the structure of IUBS that had taken place since the XX General Assembly of IUBS in 1979 (see para 9 above). The division of Microbiology had now left IUBS and had been formed into an International Union of Microbiological Societies (IUMS). The board of the Division of Botany and Mycology of IUBS had also considered structure at a meeting on 23 August during the Sydney Congress. The Board resolved to urge IUBS to maintain the present Division of Botany and Mycology, to recognize the Chairman of that Division as the voting member of the IUBS Executive, and to delegate budgetary responsibility for the Division on the Board. It was further proposed that the President of the Division would be that of each individual International Botanical Congress and that he would serve for three years before to three years after the Congress.

9. *Relationship with IUMS*

25. The Meeting noted the establishment of IUMS, and that it included a Division of Mycology. The Secretary summarized a letter he had received from Dr. Iwata (Chairman of that Division) hoping that the two organisations would collaborate in fostering actual co-operation in developing mycological research in all its fields. After some discussion it was agreed that the informal links that had previously existed when the Division was a Section within the Division of Microbiology of IUBS should be maintained, but it was not considered to be appropriate to enter into any formal relationship with IUMS at that time.

10. *XII General Assembly of IUBS*

26. No proposals had been received, but the Meeting agreed that the IMA should support any applications received from the International Association for Lichenology (IAL) or the International Society for Human and Animal Mycology (ISHAM) for recognition as Sections with the IUBS Division of Botany and Mycology.

27. It was agreed that the President, Secretary and (if possible) Dr.S.J. Hughes Vice-President IMA should represent the IMA (section for General Mycology) at the General Assembly.

11. *Liaison Office*

28. The secretary regretted that further progress had not been made in efforts to seek funds to establish a Liaison Office for world mycology as recommended by IMC2.

12. *Any other business*

Professor K. Esser informed the Meeting that the XIV International Botanical Congress would be held in Berlin in 1987. The venue would be a conference centre which could contain 7000 delegates and Professor Esser invited the IMA to hold IMC4 conjointly with that Congress. After some discussion, the Meeting agreed that Professor Esser should explore the possibilities further. This, and any other offer to host IMC4, would have to be considered by the Executive Committee of IMA prior to IMC3. The Executive would hope to be able to make a firm recommendation to the IMA General Assembly to be held during IMC3.

30. In closing the Meeting, the President thanked all the mycologists who had made time in their busy Congress Schedules to participate, and also paid tribute to the support he had received from the Officers of the IMA.

28 April 1982

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Secretary, IMA.

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NOTICE

FURTHER SUGGESTIONS FOR MYCOTAXON AUTHORS

The most frequent cause for rejection on just technical grounds for manuscripts submitted to MYCOTAXON continues to be lack of attention to requirements to save space. The worst offense continues to be leaving a blank line between references cited. When retyping will not save a page, such manuscripts have been accepted, but typists must learn to try to save as much space as possible. Typing all the way to the edges of the blue rectangles called for in the instructions to authors is also essential. Too often typists leave space there.

The availability now of fairly inexpensive "intelligent" typewriters that can produce right-justified copy, and, in some laboratories, of word-processors, makes it possible to produce much more printing-like camera-ready copy. Two problems have arisen with the word-processed manuscripts: some authors have miscalculated page length, and produce copy too short for our format; such manuscripts are normally returned for reprocessing with the correct page length. The second problem involves those word-processors which produce a typeface appreciably **smaller** than elite (10 point) type. When such copy is prepared on an elite rectangle (i.e., one 12.5 cm wide), the resultant reduction causes the typeface to become too small to read easily. Authors with such equipment at hand should use a smaller rectangle. Often this will be one 11 x 17.6 cm., which would result in the copy being printed **without reduction** at the same size as submitted. Please consult a Co-Editor if you have any questions about appropriate methods of manuscript preparation.

Again, the Co-Editors call your attention to the possibility of saving space by condensing your literature cited, either running on references or typing using a larger rectangle. Suggested methods are detailed in MYCOTAXON 6: 370. 1977.

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OF RESEARCH ON TAXONOMY & NOMENCLATURE OF FUNGI & LICHENS

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SANCTIONED EPITHETS, SANCTIONED NAMES, AND CARDINAL PRINCIPLES IN ": PERS." AND ": FR." CITATIONS

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ABSTRACT

A historical perspective on the International Code of Botanical Nomenclature is given on (1) the establishment in 1910 of later starting-point works for fungal nomenclature (Persoon's **Synopsis Methodica Fungorum** of 1801 and Fries's **Systema Mycologicum** of 1821-1832), and (2) the dilemma of 1950-1981 in citing author citations for early species names once a 1 Jan. 1821 starting-point date had been established for 'fungi caeteri.' The concept of sanctioned names (and epithets), introduced into the Code at the Sydney congress in 1981, is explained. An urgent plea is made to mycologists to find holotypes or to designate lectotypes or neotypes of sanctioned names so that taxonomic mycology can proceed on a sound footing. Some principles in the practical application of the ": Pers." and ": Fr." system of notation for sanctioned names and epithets, also introduced at Sydney, are elucidated.

A BRIEF HISTORY OF LATER STARTING-POINT BOOKS AND DATES, AND OF THE ORIGIN OF "SANCTIONED" NAMES

At the 1910 (Brussels) International Botanical Congress (IBC) various later starting points for the nomenclature of plants were adopted where use of Linnaeus's **Species Plantarum** was felt ill-advised. For fungi four different starting-point works were named: Linnaeus's **Species Plantarum** (1753) was accepted for a starting- point book for myxomycetes and for lichens; Persoon's (1801) **Synopsis Methodica Fungorum** for rusts, smuts, and gasteromycetes; Sternberg's (1820) **Flora der Vorweldt** for all fossil plants (including fossil fungi); and Fries's 3-volume (1821-1832) **Systema Mycologicum** for all other fungi (termed the "fungi caeteri").

All fungal groups, except fungi caeteri, had a single volume as the starting-point book. Between 1910 and 1950 an often lively debate arose over how to interpret the 1821-1832 date-spread as a starting point for fungi caeteri. A few authors held that the starting point should be 1821, and that all names published after that date were validly published. Others held that names published prior to 1832 had no status and were not validly published except in the **Systema** itself. Still others assumed each group of fungi had its starting point on the date that Fries took up that group in the **Systema**. Thus agarics and aphyllophoralean fungi would mostly date from 1821, as would the Geoglossaceae of the Discomycetes; many other Discomycetes would date from vol. 2(1) of the **Systema** in 1822; the remaining Discomycetes in 2(2) in 1823; etc.

Because precision in dating nomenclatural matters is essential, a major change was enacted at the 1950 (Stockholm) IBC in which actual or arbitrary publication dates were set for starting-point works, and nomenclature for each of the groups was now defined as beginning on a particular **date** (rather than book). The dates which concern us were 1 May 1753 for Linnaeus's **Species Plantarum**, 31 Dec. 1801 for Persoon's **Synopsis**, 31 Dec. 1820 for Sternberg's **Flora**, and 1 Jan. 1821 for **volume 1** of Fries's **Systema**. (The other volumes of the **Systema** were not arbitrarily dated.)

The whole purpose of adopting later starting points had been to attain stability in nomenclature, recognizing that, in the case of fungi, there were two early authors, Persoon and Fries, who had brought some semblance of order out of the chaos of their pasts. The intent in 1910 was to build upon their taxonomy (and thus their interpretations of the taxonomy and nomenclature of earlier works). With the adoption of a starting-point **date** of 1 Jan. 1821, all those fungi caeteri in volumes 2 and 3 of the **Systema** were deprived of a starting-point **book** for reference. Since this was clearly at odds with the intent of having Fries's **Systema** serve as a later starting point, the 1950 IBC adopted a method of providing **priviledged status** to the names in those two volumes. They extended that priviledged status also to the names used by Fries in the 2-volume **Elenchus Fungorum** (1828), correctly seen as a true supplement to the **Systema**. The exact wording adopted for Art. 23f of the Stockholm Code was:

> f. FUNGI CAETERI, 1 Jan. 1821 (Fries, Systema Mycologicum Vol. 1). Vol. 1 of the Systema is treated as having appeared on 1 Jan. 1821, and the Elenchus Fungorum (1828) is treated as part of the Systema. Names of FUNGI CAETERI published in other works between the dates of the first (Vol. 1) and last (Vol. 3 part 2 and index) parts of the Systema which are synonyms or homonyms[1] of names of any of the FUNGI CAETERI included in the Systema do not affect the nomenclatural status of names used by Fries in this work.

The wording was not felicitous, since there is no definition of what the "nomenclatural status" of Fries's names is. The French text is perhaps clearer" "... n'ont point de répercussion sur la nomenclature des noms utilisés par Fries dans son ouvrage." The names in vols. 2 and 3 (and in the **Elenchus**) were thus accorded a special kind of priority as protected or priviledged names, and the whole **Systema** was in some ways still a "starting-point book." For these priviledged names Donk (**1961**) coined the term "sanctioned" names. He also suggested adding an indication of such sanctioned status, ": Fr.," to those names which were **validly** published **prior** to the date that they were treated by Fries in the **Systema**. [Since valid publication of fungi caeteri did not begin until 1 Jan. 1821, the ": Fr." notation was only to be applied to names published in **other** works between 1821 and 1832 (index) that were adopted (in some form) by Fries in the **Systema/Elenchus**.] Though Donk's formal proposal for this system of notation was rejected at the next IBC, many workers, myself included, found it so useful that they often adopted this system in their publications.

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[1] A reminder to the reader: a synonym is a different name for the same taxon based on the same or on a different type; a homonym is the same name based on a different type.

THE 1950-1981 DILEMMA: AUTHOR CITATIONS

With the adoption in 1950 of 1 Jan. 1821 as the starting-point **date** for fungi caeteri, new problems in citing authorities arose. A single example is chosen here to illustrate how the many variations in permissible author citations came into being.

Peziza araneosa Bull. 1791, if it had been a plant with a 1753 starting point, would have complied with all the requirements for valid publication. Since it is a member of the fungi caeteri, it was "devalidated" (a term coined by Donk, **1957**) by provisions of later starting points. Fries accepted this species in Syst. Myc. 2(1): 69, 1822. Prior to 1959 the International Code of Botanical Nomenclature (ICBN) permitted citation of this name in three ways:

(1) **Peziza araneosa** [Bull.] Fr.

(2) **Peziza araneosa** Bull. ex Fr.

(3) **Peziza araneosa** Fr.

The first two options clearly identified the source of the name, and thus of its type specimen; the third obscured the origin of the name. The foolishness of having two different ways of indicating a pre-starting-point author, square brackets and "ex," and the problem caused by thus introducing a different meaning for "ex" than used elsewhere in the ICBN, has been detailed elsewhere (Donk, **1957**). In the 1959 and 1964 Codes only citations (1) and (3) are approved. A reversal of this occurred in the 1969 and 1975 Codes, where only options (2) and (3) are approved. [The change was made (unwisely!) by the Editorial Committee, and not voted upon by the Congress. A proposal by Compère (**1973**) to restore square brackets instead of "ex" was not accepted at the Leningrad (1975) IBC.]

With the adoption in 1950 at Stockholm of a starting-point date of 1 Jan. 1821 a wholly new problem arose: whosoever **first** adopted the name after that date became the validating author (or, better, in Donk's terminology, the "revalidating" author of a devalidated name). The immense difficulty of ascertaining the name of this validating author was not given serious consideration by those who adopted the 1950 ICBN. The problem has been discussed at length elsewhere (Korf and Kohn, **1979**, **1980**; Demoulin et al. **1981**) and need not be restated here. Under the 1950 Code Bulliard's name (above) had special status since it was "sanctioned" by its use in Fries's **Systema**. **But the author citation was no longer that of the pre-1950 Codes**, for Fries only took up the name in late 1822, and at least four authors used it in 1821 (and at least one other author earlier in 1822 than Fries).

Extensive and painstaking bibliographic research over the years by such experts as Donald P. Rogers and Ronald H. Petersen (see Korf, **1982a**) has led to **partially complete** sequencing of the various books published in 1821 (and, to a much lesser extent, those published in 1822 and later). But for some 1821 books and articles an exact date of publication (and therefore their position in the sequence) will never be able to be established. (One could, of course, legislate arbitrary dates of publication for all of them!). Of the four known competing treatments in 1821 that adopted **Peziza araneosa** Bull., we know (Petersen, **1975**) that St.-Amans's **Flore Agenaise** was published between the 20th and 28th of April, Mérat's **Nouvelle Flore** between the 9th and 15th of June, and Purton's **Appendix** after August 1st. But Nocca and Balbis's **Flora Ticinensis** is, in Petersen's words, "unsequencable."

The 1950-1975 Codes left us with four[2] possibly correct citations:

(4) **Peziza araneosa** Bull. ex St.-Amans

(5) **Peziza araneosa** Bull. ex Nocca & Balb.

(6) **Peziza araneosa** St.-Amans

(7) **Peziza araneosa** Nocca & Balb.

For **none** of these was Fries's name to have any part in the citation, for his action in 1822 was **after** the starting-point date. Citations **(4)** and **(5)** had at least the merit of telling us where the type of the name is to be found (Bulliard's specimens if extant, publications, figures). Citations **(6)** and **(7)** make matters quite abstruse, since neither St.-Amans's nor Nocca and Balbis's works are available in many libraries, nor were they cited by Fries, Mérat, or Purton. On the contrary, even if Bulliard's work is not in many libraries, it **is** cited by Fries and by every one of the above authors, as it was the basis of all their treatments. (It is, moreover, now easily available on microfiche.)

And yet a further question haunted us: did Rogers and Petersen really exhaust the 1821 literature? Would someone unearth another obscure 1821 work using Bulliard's name?

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[2] I am intentionally ignoring two additional citations, **(4a) Peziza araneosa** [Bull.] St.-Amans and **(5a) Peziza araneosa** [Bull.] Nocca & Balb., permitted under the 1950 and 1954 Codes and demanded instead of **(4)** and **(5)** by the 1959 and 1964 Codes.

For example, a publication by Apocryphal, either in Jan.-Mar. 1821 or of undeterminable date within 1821, would yield two additional possibilities:

(8) **Peziza araneosa** Bull. ex Apocr.

(9) **Peziza araneosa** Apocr.

No "stability" in nomenclature arose from these changes in the Code in 1950: indeed, mycologists who wished to follow the Code were forced to leave their field work and their microscopes and to head for the dustiest library shelves to look at musty local floras, emerging finally with an author citation that - at best - "might" be the correct one!

THE 1981 CODE: SANCTIONED NAMES AND A UNIFORM STARTING POINT

In an effort to obviate the drudgery of sterile library searches that led to sometimes conflicting, sometimes unresolvable problems, a subcommittee of the Nomenclature Secretariat established in 1971 by the International Mycological Association made a series of proposals (after years of work and good-intentioned if not always good-natured infighting) that resulted in changes in the ICBN enacted at Sydney during the 1981 IBC. In brief, these restored Linnaeus's **Species Plantarum** (1 May 1753) as the starting point for all recent fungi (fossils still start in 1820), but at the same time gave protected status to the names adopted by Persoon in the **Synopsis** (1801) for rusts, smuts, and gasteromycetes, and to those adopted by Fries in the **Systema/Elenchus** (1821-1832) for fungi caeteri (excluding myxomycetes). Donk's term "sanctioned" was employed for any name "adopted" in those named works in the respective groups. Donk's proposed ": Fr." notation (for indication of a name "revalidated" by some other author than Fries that had, at a later date, been adopted in the **Systema**) was taken up in a modified form, since there are now two sanctioning works. (Persoon's names in the **Synopsis** were published under 1950-75 Codes on their own later starting point date, 31 Dec. 1801, and had automatic priority; to maintain that priority, sanctioning status was necessarily extended to that work.)

What did this do to our example fungus? It changed the status of Bulliard's 1791 name from "not validly published" to "validly published," since it appeared after 1 May 1753. By examination of the **Systema** we discover that Fries "sanctioned" the name. We need never look in the library for the works of St.-Amans, Mérat, Purton, or Nocca and Balbis in regard to this fungus, for they no longer have any nomenclatural impact; their sole claim to our current interest lies in distributional records or possible misidentifications. Likewise, we need never fear the discovery of "Apocryphal's" 1821 treatment. **The new Code now permits only two citations:**

(10) **Peziza araneosa** Bull.

(11) **Peziza araneosa** Bull. : Fr.

For many purposes the first will suffice. For certain situations the latter will be better, for it conveys an additional bit of information: "this name has been sanctioned by Fries." As we shall now see, sanctioning is a two-edged sword, having to do not only with priorability of names, but also with typification of names.

SANCTIONED NAMES: PROTECTED AGAINST SYNONYMS AND HOMONYMS

Under the 1950-1975 Codes, names of fungi caeteri adopted by Fries in vols. 2 and 3 of the **Systema** and in the **Elenchus** were granted a priority over competing names (i.e., names at the same rank) published after 1 Jan. 1821 and before the index to vol. 3 (1832), whether these were synonyms or homonyms. Under the 1981 Code, all those names not only retain that priority status, but now similar status extending all the way back to 1753 has been extended to them and to all of the names of fungi caeteri adopted (sanctioned) by Fries in vol. 1 of the **Systema** and also to all of the names of rusts, smuts, and gasteromycetes sanctioned by Persoon in the **Synopsis** (1801). Sanctioned names are protected **only at the rank assigned them by Persoon or by Fries** in the sanctioning work, since priority is always rank-limited under ICBN (Art. 60.1. "... In no case does a name or epithet have priority outside its own rank").

TYPIFICATION OF SANCTIONED AND UNSANCTIONED NAMES

A very significant aspect of the changes adopted at Sydney was a further attempt to attain stability in application of sanctioned names. The ICBN is based on the type method, and though specific and infraspecific names have long been recognized as having **specimens** as their types, the Sydney Code makes amply clear that the names of all taxa, e.g., generic names, ultimately have **specimens** which fix the application of the name. For many early fungal names type specimens no longer exist, and for unequivocal application of a name, nomenclatural stability requires us to propose a **neotype** to fix the application of such names. Words and drawings cannot be sectioned, nor can reagents be applied to them to determine reactions. Under the Sydney Code the type of a sanctioned name may be selected not only from the original author's material, but also from the material of the sanctioning author or from material he cites by reference. Sometimes an early author's herbarium yields one or more specimens bearing the name in question, but their status as **holotype** or **syntype** material may be open to serious question. It should now be possible in most cases to choose a **lectotype**, or, far more frequently, a **neotype**, which corresponds to **current usage** of a name, as viewed through the eyes of the sanctioning and the original authors. When these two disagree, the choice should be based on whichever will cause the least discomfort and disruption of taxonomy. Neotype specimens will be able to be sectioned, examined, and characterized. A great advantage of these neotypes over the generally "lost" original materials is that they can be abundant collections, well-dried, and adequately characterized when in fresh condition. They would ideally serve the ends desired by Smith (1977: 123-125, 150-155) for "representative" specimens. I have discussed most of the processes of typification of sanctioned names elsewhere (Korf, 1982a, 1982b), and shall not belabor the matter further here.

Since the type method requires suitable types, mycologists must now devote themselves (1) to finding holotypes when they exist, (2) to designating lectotypes from undoubted "original material," and, far more frequently, (3) to providing adequate neotypes for old names that are now 'typified' by illustrations ('iconotypes') or by descriptions alone.

First in importance will be specimen typification of names used in the two sanctioning works. Scrupulous care must be used in designating neotypes, as the Code reminds us, but such care will result in neotypes (preferably topotypes from the type locality) that will fix the names as currently employed (at least in a great majority of cases). Only later will we need to consider names placed in synonymy by the sanctioning authors, or names overlooked or ignored by them. When such an early name, after specimen typification, competes with a sanctioned name, it will merely fall into synonymy with the sanctioned (protected) name. If such a name turns out not to be treated in the sanctioning work, it also will need to be specimen typified and will date from the date of its original publication. The principle of priority will in some cases then force us to adopt an old, forgotten name instead of a name in use but described later. This particular argument was advanced as a reason for not abandoning later starting points, but if priority is to be served (and it is a guiding principle of our Code) then it should be allowed to operate. If Quélet renamed a species in the 1880's that Bulliard had previously described in 1791, why should we continue to give credit to Quélet when Bulliard had come to the same conclusion nearly a century earlier? Where such later species names are of "major economic importance," we can resort to species conservation.[3]

SANCTIONED NAMES OR SANCTIONED EPITHETS?

It is unfortunate but true that legislators often make semantic errors. What zoologists call a "species name" botanists call a "species epithet." The various editions of the ICBN have been plagued by use of 'name' in many places where 'epithet' had been intended. One of the most flagrant of these errors has been in regard to what is 'protected' in Fries's **Systema/Elenchus** (and now in Persoon's **Synopsis**) by the 1950-ff. Codes. Remember that the wording was (and still is) "Names of FUNGI CAETERI ...." What was intended was not only that **names** used by these authors were to be preserved, but also **epithets**, as can best be shown in an example:

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[3] Though **nomina specifica conservanda** were (at long last) permitted under the Code adopted at Sydney in 1981, what botanists really intended to do, I remain convinced, was to conserve species epithets, not species names. The Vice-Rapporteur (Greuter and Voss, 1982: 54-55.) explained that under the new provisions of Art. 14 what will be conserved are **basionyms.** These are conserved against all homonyms and against all listed synonyms. When the epithet of that conserved basionym is transferred, it retains its priority (at the same rank) against any combination based on a rejected name. Horrendous circumlocutions were introduced into the new wording of Art. 14 merely to avoid admitting that we wanted to conserve species epithets rather than species names.

Agaricus melleus Vahl was published in 1790, and is a sanctioned name in Fries's **Systema**. One of the synonyms cited by Fries is **Agaricus obscurus** Schaeff., published in 1762. With the new 1753 starting-point date, **both** names are validly published, and were it not for the sanctioned status accorded Vahl's name, we would be obliged to take up Schaeffer's name on the basis of priority.[4] This is the fungus known today as **Armillaria mellea** [or as **Armillariella mellea** by those who (I agree with Watling et al., **1982**) have selected an ineligible type for the name **Armillaria**]. If it is indeed Vahl's **name** that was sanctioned by Fries, what happens when we treat the epithet in another genus, **Armillaria** or **Armillariella**? Neither **Armillaria mellea** nor **Armillariella mellea** were names sanctioned by Fries, and neither would have priority status over the names "**Armillaria obscura** (Schaeff.) Author-X" or over "**Armillariella obscura** (Schaeff.) Author-Y." It was certainly never the intention of those who framed the wording in 1950 that gave priviledged status to Fries's works nor those who adopted almost identical wording in 1981 for providing sanctioned status for Persoon's and Fries's works that old names synonymized in the protected works could ever rise again to haunt us nomenclaturally! When they wrote "Names of FUNGI CAETERI ..." they clearly meant "Names **and epithets** of FUNGI CAETERI ..." were to be accorded sanctioned status. Not only are the several generic and suprageneric names in the sanctioning works to have privileged status (at their rank), but likewise **epithets** (infrageneric epithets, specific epithets, and infraspecific epithets) have a priviledged status. When such epithets are transferred (and retain their same rank) it was clearly our intent that they should retain their special status.

Another very important point needs to be made here: sanctioned names and epithets are sanctioned against **all** "synonyms and homonyms," **whether these are mentioned in the sanctioning work or not.** In this regard **sanctioned** names differ markedly from **conserved** names. Both take priority over homonyms whether cited or not, but conserved names take priority **only** over those earlier synonyms that are specifically listed in the Appendices as **nomina rejicienda**.[5]

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[4] For our purposes here we shall assume that Fries was correct in synonymizing the two names, and that they are indeed taxonomic synonyms.

[5] Ever since first introduced, conserved family names have lacked listed nomina rejicienda despite the Codes' requirements that this be done! A new 'housekeeping' proposal was introduced on the floor at Sydney (Greuter and Voss, **1982**: 51-52) to exempt family names

In our example, **Agaricus melleus** Vahl. : Fr. is also protected against discovery of **any** pre-1790 name, even one not cited by Fries, which we conclude is a synonym. (And, as I have shown above, the intent is that the epithet "**mellea, -us, -um** Vahl. : Fr." is similarly protected in **Armillaria** and in any other genus to which it may be transferred at species rank.)

RANKS OF SANCTIONED NAMES

Anyone who has worked with the sanctioning books will be well aware that though genera and species are easily recognized ranks, many of the suprageneric taxa bear ranks unlike those in modern use, while many of the infrageneric categories are undesignated or are at times at ranks not permited under the Code.[6] Infraspecific categories are similarly of several levels, often not indicated; following tradition, "the rank of subspecies under species is marked by letters or figures; that of varieties by the series of Greek letters, α, β, γ, etc. Groups below varieties and half-breeds (mule of florists) are indicated by letters, figures or typographical signs, according to the will of the author" (de Candolle, **1868**). (Art. 35 of the ICBN deals in detail with cases where clear indication of rank is not provided.) What mycologists must now keep in mind, of course, is that even if the rank of the taxon in one of the sanctioning works is uncertain, the name is nonetheless sanctioned, and thus the sanctioning treatment should be weighed when typifying a name (at whatever rank!). Unlike priority, which is inoperative outside rank, typification remains constant, even though rank may change. Should **Agaricus melleus** be reduced to subspecific or varietal rank under another species name, it would retain the same type specimen it had when originally published at species rank (or when neotypified at any rank).

SOME CARDINAL PRINCIPLES FOR ": PERS." AND ": FR." CITATIONS

Having spent something over two years now working with how to cite names under the new provisions adopted at Sydney, I have come to see several possible pitfalls. Perhaps I can prevent others from repeating my mistakes. The main difficulty has been in attempting to make these notations do more than one job, in a mistaken sense that economy of citation is an ideal. Once it is firmly entrenched in one's mind that such notation **only** indicates sanctioning of the particular generic or suprageneric name or infra-

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from the requirement to list nomina rejicienda. The Rapporteur-Général saw no problems arising over the proposal. Yet a clear distinction was thereby made between the treatment of conserved generic and specific names and those of families. The treatment now afforded conserved family names comes closer to the priority aspects of sanctioned fungal names than it does the priority aspects of conserved generic or specific names.

[6] The pertinent rule of the Code (Art. 33.4, 33.5) makes an exception for Fries's taxa termed "tribes" (tribus) in the **Systema**, "which are treated as validly published." No other misplaced ranks are permitted.

generic, specific, or infraspecific epithet, then use of the notation system becomes unambiguous and easy to apply.

Principle 1

": Pers." and ": Fr." are notations which may be left out of author citations in non-taxonomic work, but should normally be used in any taxonomic treatment, since they convey information about priorability, typification, or both.

Principle 2

Sanctioning is independent of rank, and the notations ": Pers." and ": Fr." in no way indicate the rank at which a name or epithet was sanctioned. The purpose of the notation is to say: "**Beware:** this name (epithet) was adopted in a sanctioning work, and has special priority and typification status."

Principle 3

Priority of sanctioned names and epithets extends only within the rank assigned by the sanctioning author. (E.g., an epithet, sanctioned at varietal level, when raised to species rank does not retain priority over an earlier, validly published but non-sanctioned species epithet.)

Principle 4

Typification is independent of rank, even when ranks differ between original and sanctioning treatments. Typification of sanctioned names and epithets must be viewed not only on the basis of the protologue of the original author, but also of all other elements referred to (directly or indirectly) in the sanctioning work.

Principle 5

When the notation ": Pers." or ": Fr." is used it must always **immediately** follow the name of the original author. Even though a sanctioning author may have sanctioned a previous combination, it is critical that the notation be inseparable from the name of the original author, for the two must be transferred together when the epithet itself changes generic placement or rank. [E.g., **Octospora applanata** Hedw. 1801 was transferred to **Peziza** in 1805 by Albertini and Schweinitz. It might seem logical to cite the name, sanctioned by Fries in 1822, as "**Peziza applanata** (Hedw.) A. & S. : Fr.," but this is illusory! When we transfer this species to yet another genus or give it another rank, it is "**applanata** (Hedw. : Fr.)" that we will want to transfer so that workers will still know of its special priority and typification status. The correct citation in **Peziza** is "**P. applanata** (Hedw. : Fr.) A. & S." If treated as a species of **Octospora**, it should be cited as "**O. applanata** Hedw. : Fr." even though Fries did not sanction it under that generic name.[7]]

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[7] Again I find here convincing evidence that it is epithets of species and infraspecific

Principle 6

When a new combination is made in one of the sanctioning works, the sanctioning author thereby simultaneously sanctions the basionym and makes the transfer. His name should appear twice. [E.g., citations such as "**Daedalea striata** (Swartz) : Fr." or "**D. striata** (Swartz : Fr.) Fr. : Fr." should be avoided for a first transfer of Boletus striatus Swartz (now **B. striatus** Swartz : Fr.). The correct format for this is "**Daedalea striata** (Swartz : Fr.) Fr." This clearly differentiates the two actions by Fries, transferral and sanctioning. To ask ": Fr." to do two jobs will lead to complications when the name is transferred again. Everything within the parentheses will transfer, and nothing outside the parentheses will do so.[8]]

Principle 7

When a new taxon is published in a sanctioning work, it is necessary in taxonomic works to cite the sanctioning author's name twice, separated by a colon. (E.g., "**Thelephora avellana** Fr. : Fr." would be the preferred citation for a new species published by Fries in 1821 in the **Systema**. Not only is the name Fries's, but when transferred it is imperative that its special priority status be recognized. So long as it is treated at the rank of species, the epithet has priority over any epithet published earlier.)

Principle 8

When two competing names of the same date have both been sanctioned, the first author to choose one over the other should be followed, in accordance with the general practice of ICBN (Art. 57.2). When they are of different date, priority of original publication will take effect (Art. 57.1).

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taxa that are sanctioned. One could argue that in this instance **both** the name (combination) "**P. applanata**" and the epithet "**applanata** Hedw." were sanctioned, but it is only critical that the sanctioning author's name be connected to the epithet when it is transferred, and of no importance that it be attached to the name (combination).

[8] A citation such as **Peziza bolaris** Batsch : Fr. var. **explanata** (Holmsk. : Fr.) Fr. conveys the information that (1) Holmskjold erected this taxon in some other genus or at some other rank, or at the rank of varietas under some other species name, (2) that the epithets **bolaris** and **explanata** are both sanctioned, and (3) that Fries (at some time) transferred Holmskjold's epithet to varietal status under **P. bolaris.** Though the transfer was actually made in the sanctioning work, the desire therefore to cite this as "**P. bolaris** Batsch : Fr. var. **explanata** (Holmsk.) : Fr." must be resisted. While that would convey the additional information that the transfer was made in the sanctioning work and not in an earlier or later publication by Fries, such is **not** the purpose of ": Pers." and ": Fr." notations. Better we know what to transfer, "**explanata** (Holmsk. : Fr.)," when the epithet is moved than particulars about when or where a combination was made, not a normal function of author citations.

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ON THE GENERA *COCHLIOBOLUS* AND *PSEUDOCOCHLIOBOLUS*

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Abstract

Intraspecific variation in the two characteristics used to distinguish *Pseudocochliobolus* from *Cochliobolus* highlight the difficulties involved in keeping these genera separate, and it is proposed that the former name be put into synonymy. The anamorphs of *Cochliobolus* species are species of *Bipolaris* and *Curvularia*, and these genera are compared. Observations on conidium septation are reported, and application of the terms 'euseptate' and 'distoseptate' is discussed. The new combinations *Cochliobolus australiensis* (Tsuda & Ueyama) comb. nov., *C. nisikadoi* (Tsuda, Ueyama & Nishihara) comb. nov., and *Bipolaris chloridis* (Alcorn) comb. nov. are proposed. In addition the combination *B. homomorphus* (Luttrell & Rogerson) Subram. is validated, and a lectotype designated for *C. heterostrophus* (Drechsler) Drechsler.

INTRODUCTION

When fungi in *Eu-Helminthosporium* (*Bipolaris*) were first shown to have ascal state connections, those teleomorphs were described as species of *Ophiobolus*. In describing *O. heterostrophus* Drechsler, Drechsler (1925) indicated that 'the leaf spot fungus is tentatively assigned to *Ophiobolus*', and that this was 'not intended to imply close relationship to certain species referred to this genus' such as *O. cariceti* (Berk. & Br.) Sacc. and

O. herpotrichus (Fr.) Sacc. Four more correlations between *Helminthosporium* species and *Ophiobolus* were soon identified. Ito and Kuribayashi (1927) described *O. miyabeanus* Ito & Kurib. as the perfect state of *H. oryzae* B. de Haan. The other species described in this period were *O. kusanoi* Nisik. (Nisikado 1928), *O. sativus* Ito & Kurib. (Ito & Kuribayashi in Kuribayashi 1929), and *O. setariae* Ito & Kurib. (Ito & Kuribayashi in Ito 1930). The anamorphs recorded for these fungi were respectively *H. kusanoi* Nisik., *H. sativum* Pamm., King & Bakke, and *H. setariae* Saw.

Cochliobolus was erected by Drechsler (1934) for the fungus he had described previously as *O. heterostrophus*. The main features distinguishing the new genus from *Ophiobolus* were greater ascus and ascospore width, the strongly helicoid arrangement of spores in the ascus, and the associated conidial state. Two species of *Ophiobolus* from *Ambrosia trifida* L. were found to produce *Phoma*-like conidial states in culture, while other species produced no anamorphs at all. In contrast the anamorph associated with the type species of *Cochliobolus* was a species of *Helminthosporium* exhibiting bipolar germination (*H. maydis* Nisik. & Miyake). Drechsler realized that several other species described in *Ophiobolus* belonged in the new genus. He included *O. kusanoi*, *O. miyabeanus*, *O. sativus*, and *O. setariae* in his concept of *Cochliobolus*, but did not formally transfer the names of these species. In addition to the four species just listed, Drechsler regarded the unnamed *Ophiobolus* states of *H. micropus* Drechsler and *H. stenospilum* Drechsler as belonging in *Cochliobolus*. Transfer to *Cochliobolus* of the names of the four *Ophiobolus* species accepted by Drechsler was made by Dastur (1942) who also added *C. tritici* Dastur. Subsequently the genus has been expanded to include 32 species, many of which have *Bipolaris* anamorphs (Table 1).

The correlation of some *Bipolaris* species with the teleomorph genus *Pseudocochliobolus* (Tsuda, Ueyama, & Nishihara 1977; Tsuda & Ueyama 1981) introduced heterogeneity into the anamorph-teleomorph connection previously thought to be predictive, namely that all *Bipolaris* species will prove to have *Cochliobolus* ascogenous states (Luttrell 1977, 1978). The differences between the two teleomorph genera are examined below.

Table 1. *Cochliobolus* species and their anamorphs

Species	Author(s)	Anamorph *
bicolor	Paul & Parbery 1966	B. bicolor
bouteloua	Sprague 1951	unknown
carbonum	Nelson 1959	B. zeicola
chloridis	Alcorn 1978	D. chloridis
cymbopogonis	Hall & Sivanesan 1972	C. cymbopogonis
cynodontis	Nelson 1964a	B. cynodontis
dactyloctenii	Alcorn 1982	B. dactyloctenii
geniculatus	Nelson 1964c	C. geniculata
hawaiiensis	Alcorn 1978	B. hawaiiensis
heterostrophus	(Drechsler) Drechsler 1934	B. maydis
homomorphus	Luttrell & Rogerson 1959	B. homomorphus
intermedius	Nelson 1960b	C. intermedia
kusanoi	(Nisikado) Drechsler ex Dastur 1942	B. kusanoi
lunatus	Nelson & Haasis 1964	C. lunata
melinidis	Alcorn 1982	B. melinidis
miakei	Hino & Katumoto 1966	unknown
miyabeanus	(Ito & Kuribayashi) Drechsler ex Dastur 1942	B. oryzae
nodulosus	Luttrell 1957	B. nodulosa
palmivora	Rao & Chaudhury 1964	unknown
peregianensis	Alcorn 1982	B. peregianensis
perotidis	Alcorn 1982	B. perotidis
ravenelii	Alcorn 1981a	B. ravenelii
sasae	Hino & Katumoto 1960	unknown
sativus	(Ito & Kuribayashi) Drechsler ex Dastur 1942	B. sorokiniana
setariae	(Ito & Kuribayashi) Drechsler ex Dastur 1942	B. setariae
sitharamii	Reddy 1976	unknown
spicifer	Nelson 1964b	B. spicifera
sporoboli	Castellani 1951	H. sp.
stenospilus	Matsumoto & Yamamoto 1936	B. stenospila
tripogonis	Alcorn 1981a	B. tripogonis
tritici	Dastur 1942	H. sp.
victoriae	Nelson 1960a	B. victoriae

* B = *Bipolaris*, C = *Curvularia*, D = *Drechslera*, H = *Helminthosporium* (sensu lato)

OBSERVATIONS ON *COCHLIOBOLUS* AND *PSEUDOCOCHLIOBOLUS*

Tsuda et al. (1977) distinguished their genus *Pseudocochliobolus* from *Cochliobolus* on two characteristics. One was the presence of stromatic tissue below the ascocarp body in *Pseudocochliobolus*. The other was the degree of ascospore coiling in the ascus, pronounced in *Cochliobolus* and slight or absent in *Pseudocochliobolus*.

Stromatic tissue

In the type species of *Cochliobolus*, *C. heterostrophus* (Drechsler) Drechsler, there was no stroma developed in association with ascocarps formed on leaves of *Zea mays* L. incubated in a moist chamber (Drechsler 1925, 1934). Numerous ascomata were produced during a study of Australian races and mating types of this fungus, but in no case was a conspicuous supporting stroma developed (Alcorn 1975). In the current study, ascomata were produced by paired cultures on Sachs' agar + maize leaf, and examined carefully for any supporting stromatic tissue. None was seen. Stromata were not induced by growing paired cultures on filter paper, maize grain, wheat straw, or *Chloris gayana* Kunth leaf (each on Sachs' agar), although ascocarps formed on these substrates. In contrast, ascomata of *Pseudocochliobolus nisikadoi* Tsuda, Ueyama & Nishihara are borne on a stroma, consisting of a short cylindrical base or a flattened crust in the substrate (Tsuda et al. 1977; pers. obs.).

In other species assigned to *Cochliobolus*, a sterile stromatic base is sometimes present below the ascogenous locule. These species include *C. ravenelii* Alcorn, *C. tripogonis* Alcorn (Alcorn 1981a), *C. perotidis* Alcorn (Alcorn 1982), *C. lunatus* Nelson & Haasis (Nelson & Haasis 1964), *C. geniculatus* Nelson (Nelson 1964c), and *C. spicifer* Nelson (Nelson 1964b). I have shown that in *C. cymbopogonis* J.A. Hall & Sivan., this characteristic is strongly influenced by the culture medium. A distinct stroma is commonly produced on Sachs' agar + *Z. mays* leaf, but only rarely formed on water agar + wheat straw (Alcorn 1981b). The ascomata of *Cochliobolus* species are ascostromatic ascocarps (Luttrell 1973), and in some species additional basal stromatic tissue occurs. It seems undesirable to use such a variable attribute as a generic criterion, and such use in the context of the taxa under discussion is rejected.

Ascospore coiling

Tsuda et al. (1977) claimed that the degree of ascospore coiling was pronounced in *Cochliobolus*, and slight or absent in *Pseudocochliobolus*. This characteristic was examined in fresh material of *C. heterostrophus* produced by pairing compatible isolates on Sachs' agar + *Z. mays* leaf. Ascocarps were crushed individually in lactofuchsin, and each mature ascus categorized with respect to degree of ascospore coiling. The following categories were used:-

(a) spores tightly coiled in a helical path over the whole length, except sometimes very near the tip where the spores tended to be parallel to the long axis of the ascus.

(b) spores tightly coiled in the lower two thirds, loosely coiled to straight in the upper third.

(c) spores loosely coiled for the whole length of the ascus.

(d) spores looped in the lower half, coiled helically in the upper half.

The number of asci in each category was counted in 18 ascocarps (Table 2). In addition to these, there were low numbers of asci in which the spores were tightly coiled in the upper and lower parts, and loosely coiled to straight in the median section; or looped irregularly for the whole length. This characteristic is thus more variable than suggested by Drechsler's account of the species (Drechsler 1925), or by the report of Tsuda et al. (1977).

Table 2. Ascospore coiling in asci of *Cochliobolus heterostrophus*

	Coiling category (see text)			
	(a)	(b)	(c)	(d)
No. asci	103	183	62	27
%	27.5	48.8	16.5	7.2

Ascospore arrangement in asci of *P. nisikadoi*, the type species of *Pseudocochliobolus*, was described as parallel to loosely coiled or very rarely coiled in a close helix (Tsuda et al. 1977). Maximum lengths of asci and ascospores were reported as 258 µm and 288 µm respectively. In an isotype specimen (IMI 214643), 75 asci from a single ascocarp were examined. Sixty asci had spores which were straight to loosely coiled over much of the ascus length. In most of these asci, spores were coiled more tightly for 20-30 µm in the apical section. Some were coiled apically and basally but were more or less straight in the median section. In the other asci examined, ascospores were classified as moderately to closely coiled over their whole length. These categories are broad, but there is a continuum between spores straight and parallel, and spores coiled in a close helix. An attempt was made to produce ascocarps of *P. nisikadoi* under the same cultural conditions as *C. heterostrophus*. Unfortunately two isolates supplied by Dr. Tsuda (1021-3, 7-3-2) failed to form the teleomorph when paired and a direct comparison was not possible.

Ascospores are loosely coiled in other species, for example *C. hawaiiensis* Alcorn, *C. peregianensis* Alcorn, *C. perotidis*, *C. tripogonis*, *C. dactyloctenii* Alcorn and *C. cymbopogonis*. In the last-named species ascospores commonly are straight and parallel for much of the ascus length, although Hall and Sivanesan (1972) did not report this fact. They described ascospores as 'closely spirally coiled in the ascus', but gave maximum lengths of asci and ascospores as 275 µm and 300 µm (rarely 420 µm) respectively. My observations on an isolate of *C. cymbopogonis* studied by Hall and Sivanesan (IMI 130402) indicate that many asci have spores only loosely coiled, or straight for much of the ascus length. Species which have some ascospores closely coiled for most of the ascus length also have maximum ascospore length greater than maximum ascus length. In contrast, where coiling is not pronounced the maximum ascospore length may be equal to or less than that of asci. Examples of the latter type are *C. geniculatus* (ascospore maximum 270 µm, ascus maximum 290 µm), *C. hawaiiensis* (190 µm, 205 µm), *C. kusanoi* (Nisik.) Drechsler ex Dastur (170 µm, 170 µm), *C. lunatus* (270 µm, 300 µm), *C. nodulosus* Luttrell (193 µm, 193 µm), *C. peregianensis* (200 µm, 255 µm), *C. spicifer* (240 µm, 260 µm), *C. sporoboli* E. Castell.

(140 µm, 140 µm), and *C. tripogonis* (275 µm, 310 µm). For *C. cymbopogonis*, the corresponding values are 370 µm and 340 µm (pers. obs.).

Discussion

Intraspecific variation in the characteristics used by Tsuda et al. (1977) to separate *Pseudocochliobolus* and *Cochliobolus* throws doubt on their use as generic differentials. I believe the evidence does not support the retention of *Pseudocochliobolus* on the grounds offered, and suggest that the name be put into synonymy with *Cochliobolus*.

ANAMORPHS OF *COCHLIOBOLUS*

The description of *Cochliobolus* included details of the anamorph, and Drechsler (1934) indicated that the new genus was 'defined in both its sexual and asexual stages'. By definition therefore, other *Cochliobolus* species should have anamorphs congeneric with *Bipolaris maydis* (Nisik. & Miyake) Shoem. Drechsler recognized that species such as *Helminthosporium geniculatum* Tracy & Earle differed from others then referred to *Helminthosporium* sensu lato, but he did not exclude them from the genus. Subsequently *H. geniculatum* and similar species have been segregated in *Curvularia* (Boedijn 1933). This genus has been considered quite distinct from *Bipolaris* (Ellis 1966, 1971; Groves & Skolko 1945; Putterill 1954), but the teleomorphs discovered for members of both genera have been assigned to *Cochliobolus* (Table 1). This would seem contrary to Drechsler's circumscription of the genus, unless *Curvularia* and *Bipolaris* are not distinct. Von Arx and Luttrell (1979) have in fact suggested that *Bipolaris* should be made a synonym of *Curvularia*. I have examined this proposal and present results of my observations below.

The genera *Curvularia* and *Bipolaris*

The genus *Curvularia* was erected in 1933, with *C. lunata* (Wakker) Boedijn as the type species (Boedijn 1933). Conidia of *C. lunata* are obovoid, curved, 3-septate, with the penultimate cell swollen, thicker walled, and darker than the other cells. *Bipolaris* was established in

1959, with *B. maydis* as the type species (Shoemaker 1959). Conidia of *B. maydis* are fusoid, curved, multiseptate, with cells concolorous and lacking any disproportionate swelling.

Ellis (1971) has provided standarized descriptions for many dematiaceous hyphomycetes. His descriptions of *Curvularia* and *Drechslera* sensu lato (which includes *Bipolaris*) reveal no differences in characteristics of the colonies, mycelium, stromata, conidiogenous cells or conidiophores. The genera are distinguished on the basis of conidium morphology, summarized for each genus in the following table. These data are drawn from the accounts by Ellis (1966, 1971, 1976).

Conidium characteristics in the genera *Curvularia* and *Drechslera* sensu lato

Curvularia	*Drechslera*
solitary or catenate	solitary or catenate
acropleurogenous	acropleurogenous
simple, often curved	simple, straight or curved
clavate, ellipsoidal, broadly fusiform, obovoid or pyriform	clavate, cylindrical, ellipsoidal, fusiform or obclavate
pale or dark brown, often with some cells paler	straw-coloured, pale to dark brown or olivaceous brown, sometimes with end cells paler
smooth or verrucose	mostly smooth, rarely verruculose
hilum flush or protruding	hilum flush or protruding
septate	pseudoseptate
swollen median cell or cells present	swollen median cell or cells absent

This comparison highlights the similarities between these genera. Curved conidia occur in both, but in *Curvularia* the curvature is often associated with a disproportionately swollen median cell or cells, a characteristic previously stressed by Ellis (1966). The conidia of many species of *Drechslera* and *Bipolaris* have numerous septa, although some have only a few. Examples of species with the latter condition are *B. australiensis* (M.B. Ellis) Tsuda & Ueyama, *D. papendorfii* (van der Aa) M.B. Ellis, *B. spicifera* (Bain.) Subram., *D. biseptata* (Sacc. & Roum.) Richardson & Fraser, and *B. ravenelii* (Curt.) Shoem. Most *Curvularia* species have only three or four septa in mature conidia.

There is an important difference in the nature of conidial septa, used by Ellis as a differentiating character in his key to genera (Ellis 1971, p. 21, couplet 193). Conidia of *Drechslera* are distoseptate (= pseudoseptate sensu Ellis), while those of *Curvularia* are septate. Luttrell (1963) has pointed out that the term 'pseudoseptate' has been used in two senses by Ellis. In the context of comparing *Drechslera* and *Curvularia*, it is clear that Ellis has used the term in the sense of 'distoseptate', and that 'septate' means 'euseptate' when applied to *Curvularia* conidia.

Euseptate and distoseptate conidia

The terms euseptate and distoseptate were introduced by Luttrell (1963). Euseptate conidia have a single wall from which true septa form as inward extensions. *Sporidesmium* and *Vakrabeeja* (= *Nakataea*) were used as examples of genera with such conidia by Luttrell. Distoseptate conidia have at least two distinct walls. There is a thin, rigid outer wall to which septa are not joined. This outer wall encloses a thick, hyaline inner wall. The distosepta delimiting cells of the conidium are formed by the inner wall alone, and the outer wall does not participate. In some fungi, for example *Bipolaris sorokiniana* (Sacc.) Shoem., the outer wall of the conidium is brittle and easily fractured by pressure. In such conidia the internal structures often can be expelled intact, revealing cells enclosed by the thick hyaline wall (Luttrell 1963).

Other species Luttrell used as examples of fungi with distoseptate conidia were *D. avenacea* (Curt. ex Cooke) Shoem., *Deightoniella torulosa* (Syd.) M.B. Ellis, and *Corynespora cassiicola* (Berk. & Curt.) Wei. In another paper, Luttrell (1964) reported that conidia of *B. maydis* and *Exserohilum turcicum* (Pass.) Leonard & Suggs were distoseptate, but that this characteristic was difficult to demonstrate in the former species because of the tough outer wall.

Observations on conidium septation in various genera

Conidia were mounted in 3% KOH and fractured by tapping or pressing on the coverslip, then stained by irrigation with 0.5% aqueous phloxine. This stained protoplasm a deep pink colour, and after some time hyaline walls became pale pink. The term 'wall' is used in the following section in a broad sense, to describe ' a morphological entity of apparent structural uniformity' (Sutton & Sandhu 1969).

Septation in *Bipolaris, Drechslera* and *Exserohilum*

Conidia of *B. maydis*, the generic type, have two distinct walls which can be demonstrated by the treatment described above. Under pressure the thin pigmented outer wall splits to release the hyaline contents. The latter sometimes emerge intact, and consist of a hyaline wall enclosing the cells of the conidium (Fig. 2). As reported by Luttrell (1964), the outer wall in this species is stronger than that in *B. sorokiniana*, and more pressure must be applied to achieve the same degree of fragmentation. The inner wall often ruptured under these conditions.

Only slight pressure is necessary to break the outer wall in conidia of *B. sorokiniana*, and the contents often can be expelled intact. A thick hyaline wall encloses more or less globose cells with deeply-staining protoplasm (Fig. 3). A fine dark transverse line is often visible between the cells. There is no evidence of torn attachment points for septa when all structures internal to the brown outer wall have been expelled.

Conidia of other *Bipolaris* species, and of *Drechslera* and *Exserohilum* species, were examined by the same method. Species in which conidia were found to be distoseptate are listed in Table 3. The brittle nature of the outer conidial wall in *B. sorokiniana* was not matched in all other species, and some resembled *B. maydis* in having a wall much more resistant to fracturing under pressure.

Luttrell (1963) raised the possibility that a third wall existed in conidia of *B. sorokiniana*, enclosing the spherical protoplasts. Evidence was obtained to support this suggestion. An inner hyaline wall was seen enclosing protoplasts in some extruded conidial contents. This third wall layer was also seen in conidia of *B. indica* Rai, Wadhwani & Tewari (Fig. 4), but in that species the inner wall was thinner than in *B. sorokiniana*. Electron microscopy has led to differing opinions on wall structure in conidia of the latter species. Cole (1973) reported that the wall in developing conidia is two-layered, while Old and Robertson (1969) and Mills (1970) recognized three distinct layers. Subsequently a fourth layer was discovered by Old and Robertson (1970).

Septation in *Curvularia* species

When conidia of *C. lunata* (the generic type) are ruptured under pressure, the wall breaks at one or both ends to release part or all of the contents. The extruded portion consists of a thick, hyaline wall ensheathing the protoplasm which often is still divided into cells by hyaline cross walls (Fig. 5). In other instances the protoplasm was continuous in the extruded portion. Often all protoplasm was expelled, leaving the extruded wall material as a more or less cylindrical tube equal to or greater in length than the conidium (Fig. 7). Expelled protoplasts sometimes retained their shape, but burst with the application of greater pressure. The dark bands which accentuate the septa in conidia of this species usually remain within the conidium, torn centrally but still attached to the outer wall. The torn segments of the septa are directed towards the point of egress of the cell contents (Fig. 5). Sometimes septa did not rupture, but bulged towards the apex or base of the conidium without releasing the cell contents. Occasionally one or more dark septa were carried out of the conidium, and remained as

Table 3. *Bipolaris, Drechslera* and *Exserohilum* species in which conidia are distoseptate

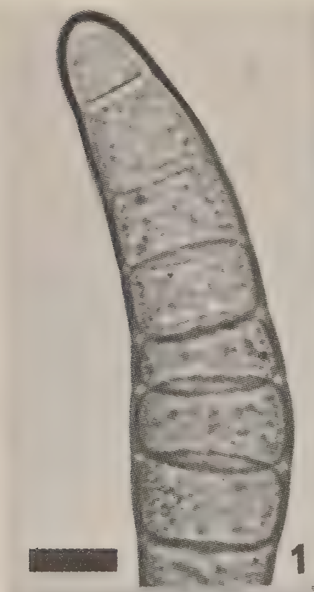
Species	Isolate *	Species	Isolate
australiensis	7750a	monoceras	7792a
australis	77126	multiformis	1215
avenae	14880	neergaardii	DAOM 154282
bicolor	77106	nicotiae	PC 2230
biseptata	PDDCC 6205	nobleae	5063
brizae	7855	nodulosa	20927
bromi	DAOM 169239	oryzae	5401
campanulata	WU.60/78	ovariicola	7813
catenaria	116-8	panici-miliacei	CBS 199.29
chloridis	7670	papendorfii	77151
clavata	77144c	pedicellatum	4951
coicis	CBS 192.29	peregianensis	7848
	7-3-2	perotidis	7905a
	1021-3	phlei	146
crustacea	1353	poae	2879
cylindrica	7835	prolatum	Ep 1
cynodontis	7842a	ravenelii	7976
dactylidis	DAOM 126766	rostratum	77162
dactyloctenii	7909	sacchari	20721
dematioidea	478	setariae	8562
dictyoides	7838a	siccans	5066
ellisii	DAOM 155097	sorghicola	7791
erythrospila	148	sorokiniana	7723
fugax	655	spicifera	77144b
gedarefensis	8021	stenospila	DAOM 147411
graminea	DAOM 159452	subpapendorfii	PC 2227
hawaiiensis	7770	teres	1535
holmii	7795b	tetrarrhenae	7725a
homomorphus	ATCC 13409	tripogonis	77158
incurvata	7783	triseptata	PDDCC 6120
indica	20114	tritici-repentis	21615
iridis	DAR 29777	tuberosa	WU.51/78
kusanoi	CBS 137.29	turcicum	77159
leersii	7704	urochloae	77127
maydis	22228	victoriae	IMI 89977 (ii)
melinidis	7837	yamadae	CBS 202.29
micropus	8452	zeicola	77107a

* Voucher specimens for all isolates used in this study are deposited in BRIP

distinctive dark bands across the expelled portion (Fig. 6). These septa appeared to have been torn from the outer periclinal wall intact. In face view these expelled accentuated septa were circular, and had a small central pore.

Twenty-five other *Curvularia* species were examined, and all were found to have conidium septum structure similar to that of *C. lunata* (Table 4). The variations in morphology of the septa and extruded contents of conidia noted for that species also occurred in some of the other species examined (Figs. 8-11). Conidia of some species were very difficult to crush, for example in *C. verruciformis* Agarwal & Sahni, *C. uncinata* Bugnicourt, and *C. geniculata* (Tracy & Earle) Boedijn. In these species each cell tends to release its contents separately from a rupture in the lateral wall, leaving the septa intact, but a hyaline inner wall can still be demonstrated. *C. catenulata* Reddy & Bilgrami and *C. tritici* Kumar & Nema are included in Table 4 on the basis of observations on intact conidia. The inner wall visible in some conidia, especially those with a swollen median cell, could not be shown by crushing, to which conidia of these two species are very resistant.

Septa in conidia of *Curvularia* species are therefore double-walled. There is a thin central pigmented plate which commonly remains attached to the periclinal wall after the conidia are ruptured, and a thicker hyaline wall which sometimes can be expelled intact. Published illustrations of *Curvularia* conidia generally indicate only a single outer wall to which septa are joined. Exceptions are provided by some of the drawings of conidia of *C. deightonii* M.B. Ellis, *C. borreriae* (Viégas) M.B. Ellis, *C. andropogonis* (Zimm.) Boedijn, *C. tuberculata* Jain, and *C. robusta* Kilpatrick & Luttrell, where an inner wall to some or all of the cells is shown (Ellis 1966, 1971). Similarly the conidia of *C. ischaemi* McKenzie are shown as either single- or double-walled (McKenzie 1981).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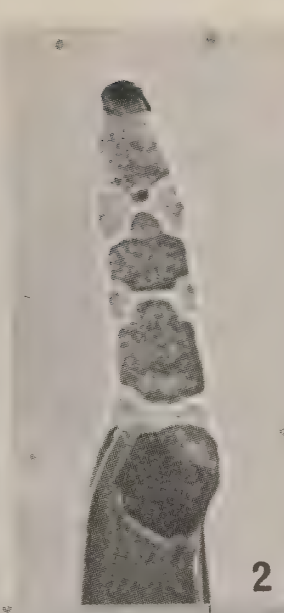
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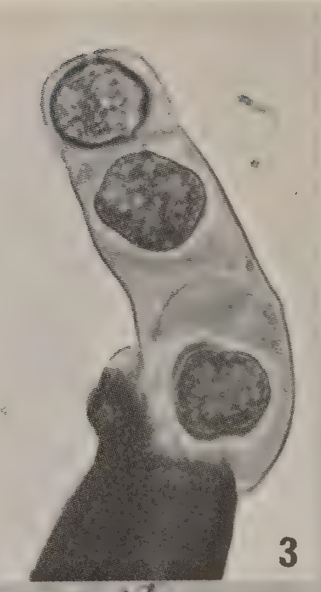
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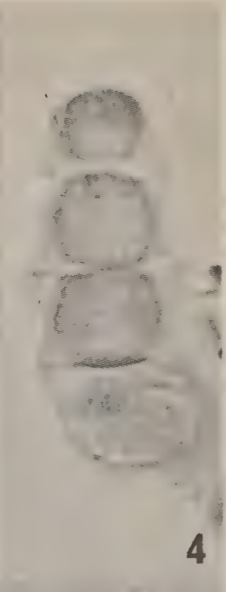
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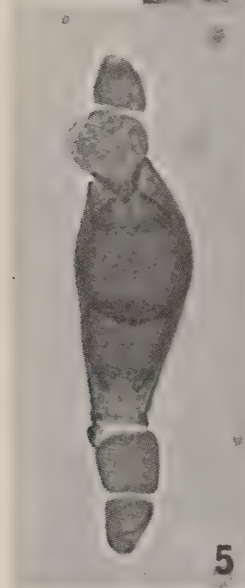
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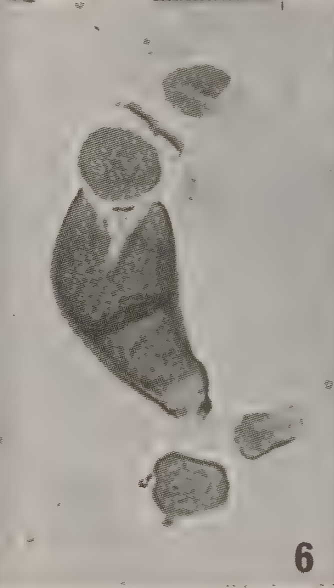
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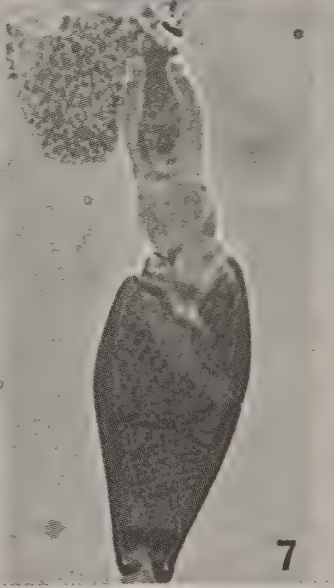
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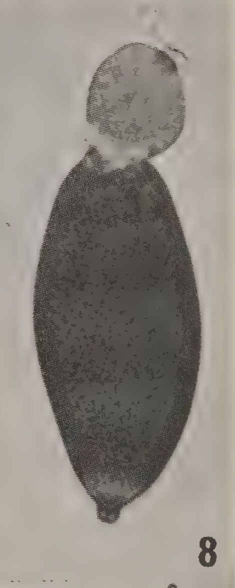
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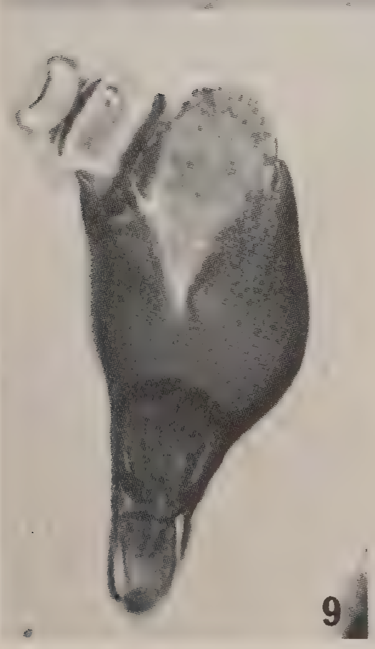
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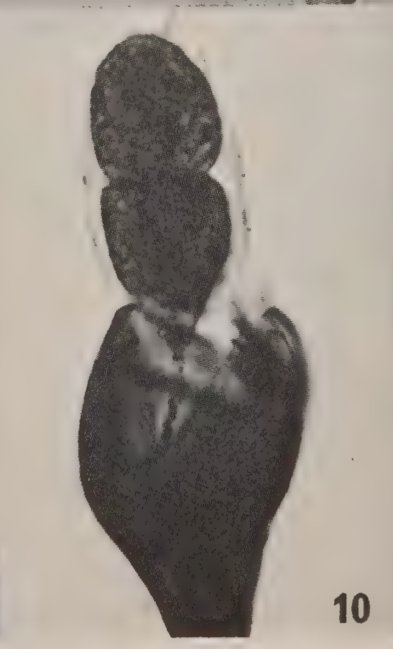
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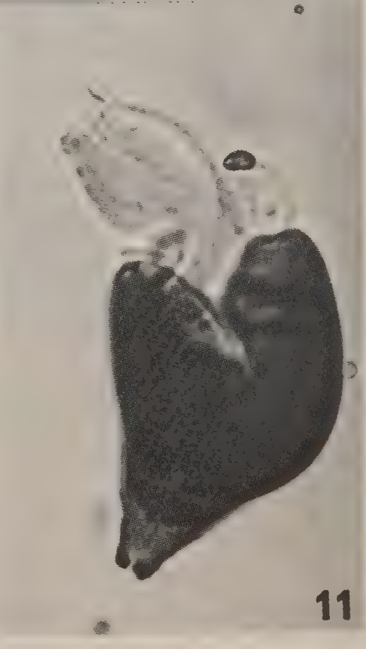
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Septation in *Bipolaris coicis*

Septa in conidia of *B. coicis* (Nisik.) Shoem. are commonly accentuated by a dark band in a manner similar to that of *Curvularia* conidia. Three isolates of *B. coicis* have been examined, namely CBS 192.29 authentic for the name *Helminthosporium coicis* Nisik., and isolates 7-3-2 and 1021-3 cited by Tsuda et al. (1977). Septum structure in conidia of these isolates is similar to that in conidia of *Curvularia* species (Figs. 12, 13), and a proposal to accept this fungus as a species of *Curvularia* could be advanced using this evidence. The binomial *C. coicis* E. Castell. (Castellani 1955) would be available; I have examined the type specimen (IMI 53422) and agree with Luttrell (1969) that the name refers to the same fungus as described by Nisikado. Characteristics other than those of septum structure, however, point to *Bipolaris* as a more appropriate genus than *Curvularia* for this taxon. Thus, curvature of conidia is not associated with a disproportionate swelling of one or more cells, nor is there any marked darkening of median cells.

Septation in *Sporidesmium* and *Nakataea*

It was found that conidia of *Curvularia* species differ in septum structure from species of *Bipolaris*. In the former genus conidia are not euseptate as narrowly defined by Luttrell (1963), who used *Sporidesmium tropicale* M.B. Ellis and *Nakataea sigmoidea* (Cav.) Hara as examples of fungi where this condition applies. The form of septation in these species has been examined for comparison with that in *Bipolaris* and *Curvularia*.

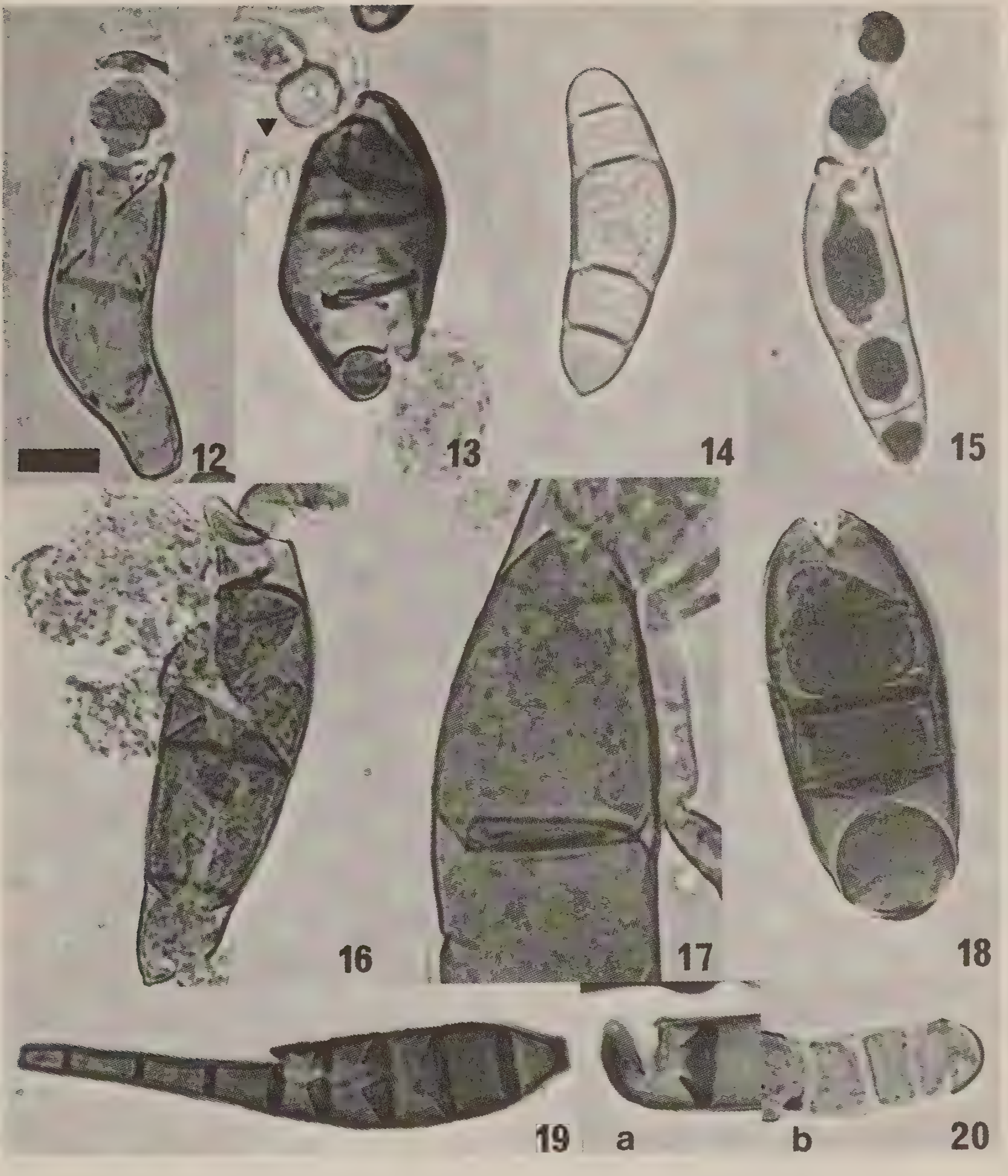
Figs. 1-11. Septum structure in conidia of *Bipolaris* and *Curvularia* spp. (1, water mount; 2-11, fractured in 3% KOH and stained with phloxine). 1 & 2. *B. maydis*. 3. *B. sorokiniana*. 4. *B. indica*. Note thin inner wall around protoplast of second cell from base. 5. *C. lunata*, with ruptured dark septa retained internally. 6. *C. lunata*, one dark septum expelled at apex; intact protoplast free of inner hyaline wall at base. 7. *C. lunata*, inner wall ruptured at apex and releasing protoplasm. 8. *C. cymbopogonis*, lower septum bulged but not ruptured. 9. *C. robusta*, lower two cells intact, upper three cells partly freed and with dark septa intact. 10. *C. richardiae*, inner wall intact. 11. *C. richardiae*, inner wall ruptured to release protoplasts. Scale = ca. 10 µm, all figures.

Table 4. *Curvularia* species in which conidia are 'euseptate'

Species	Isolate	Species	Isolate
affinis	MRL.1085	lunata	81151
andropogonis	19862b	oryzae	IMI 103899
brachyspora	8130	ovoidea	MRL.1222
catenulata	MRL.1175	pallescens	MRL.1086
clavata	8123c	prasadii	MRL.1087
cymbopogonis	IMI 130402	protuberata	7788c, ATCC 16397
eragrostidis	81114b		
fallax	IMI 102690	richardiae	7708
geniculata	IMI 103902	robusta	ATCC 16788
harveyi	WA.227	senegalensis	8025
inaequalis	MRL.1091	trifolii	77169
intermedia	8013b	tritici	MRL.1193
ischaemi	PDDCC 6142	uncinata	77153a
		verruciformis	IMI 115252

An authentic specimen of *Sporidesmium tropicale* (IMI 41526, dupl. in BRIP) was examined. Conidia of this species commonly rupture laterally. The cell contents are not enclosed in a second wall as occurs in *Curvularia* conidia, and when released often assume a diffuse amorphous shape. The conidial septa rupture in a manner similar to that described for *Curvularia*, however, with the torn fragments directed towards the cell where pressure was released by partial or complete expulsion of the protoplasm (Fig. 19).

Splitting laterally under pressure is also common in conidia of *Nakataea sigmoidea*. Again there is no suggestion of a thick hyaline inner wall similar to that seen in *Curvularia* conidia. Under moderate pressure the larger median cells usually rupture, with much more pressure necessary to break the polar cells. Septa break in the same way as do those of *Sporidesmium tropicale* (Fig. 16). Unlike the conidia of *S. tropicale*, those of *N. sigmoidea* appear to be double-walled, at least in the median two cells. There is often a small triangular space where the middle septum meets the periclinal wall. In some conidia this space is much larger, and it appears that the cells on either side of the median septum have walls which are structurally distinct from the outer conidial wall (Fig. 17).



Figs. 12-20. Septum structure in conidia of *Bipolaris*, *Curvularia*, *Drechslera*, *Nakataea*, and *Sporidesmium* spp. (14, water mount; others as for Figs. 2-11). 12. *B. coicis*, ruptured dark septa internally, distal septum carried out intact. 13. *B. coicis*, face view of expelled dark septum (arrow). 14. *C. protuberata*, conidium from hyaline mutant (7788c). Compare with Fig. 1. 15. *C. protuberata*, hyaline mutant. 16. *N. sigmoidea*. 17. *N. sigmoidea*, detail of median septum, showing triangular space where septum meets periclinal wall. 18. *D. triseptata*, inner wall constricted at accentuated septum. 19. *S. tropicale*. 20. *D. erythrospila*, ruptured dark basal septum (a), and distoseptate inner portion expelled from apex (b). The cap on this structure is the apical part of the dark outer wall, freed during rupturing. Scale = ca. 6.5 μm Fig. 17; 10 μm all other figures.

The septa delimiting the end cells appear to be formed by a single wall, namely the inner wall surrounding each median cell. The limitations imposed by light microscopy prohibit an unequivocal statement about septation in this species, but it may be similar to that described for *Seiridium* (Roberts & Swart 1980), which has thinner-walled, paler end cells.

Discussion

Cochliobolus as defined by the type species *C. heterostrophus* has anamorphs in *Bipolaris*. The discovery that some *Curvularia* species have teleomorphs which apparently could be referred to *Cochliobolus* has introduced a divergence from that principle. It has also raised the question of whether *Bipolaris* and *Curvularia* are distinct. Conidia of the former genus are distoseptate, while those of *Curvularia* can be termed euseptate in a broad sense, but not in the way used by Luttrell (1963) when referring to *Sporidesmium tropicale*. He defined euseptate conidia as being 'surrounded by a single wall and have true septa formed as inward extensions of the lateral walls'. In a glossary of new terms at the end of the paper cited, a less restrictive definition than that given above was included, that is - 'Euseptate: conidium with true septa consisting of diaphragms merging peripherally with the lateral walls'. The latter terminology presumably would allow for the existence of a wall or walls other than the lateral wall from which the septa originated. In this study, such a wall was demonstrated in conidia of *Curvularia* species.

Mangenot and Reisinger (1976) recognized three distinct categories of septal walls in conidia. In their classification the septa are defined as outgrowths of a single wall (euseptation), or from a second inner wall (distoseptation). A third type, called a double process by Mangenot and Reisinger, involved both walls in the formation of septa. Conidium septation in the *Curvularia* species examined during the present study is referable to this last type, rather than to euseptation as narrowly defined, and perhaps could be referred to as 'secondarily euseptate'.

Considerable intergeneric variation in conidium septum structure can be demonstrated by simple manipulation and observation by light microscopy. The results reported above show that uniformity in septum structure occurs within genera such as *Bipolaris* and *Curvularia*. They also support the observations of Sutton (1969) that classification of septa into two categories might prove to be an oversimplification. Roberts and Swart (1980) concluded that the terms euseptate and distoseptate had not been clarified by studies of conidium fine structure in *Pestalotiopsis*, *Seiridium*, and similar genera, and that further elucidation was necessary before they could be used to indicate distinctions of taxonomic importance.

HOLOMORPH TAXONOMY FOR *COCHLIOBOLUS*

The genus *Cochliobolus* has been used to accommodate fungi with anamorphs in *Bipolaris*, and also fungi with anamorphs in *Curvularia*. This apparent heterogeneity depends on the recognition of these anamorph genera as distinct. Von Arx and Luttrell (1979) have suggested that *Bipolaris* should be made a synonym of *Curvularia*. If this were done, all anamorphs of *Cochliobolus* would be in *Curvularia*. I think it is preferable to maintain these genera as distinct, especially in view of the evidence on septum structure presented in this paper. If other conidium characteristics are intermediate between those of *Bipolaris* and *Curvularia*, then a consideration of septum structure should allow taxa of otherwise uncertain affinities to be placed in one or other of these genera.

If *Curvularia* is accepted, then the suitability of *Cochliobolus* as a name for fungi with *Curvularia* anamorphs must be considered. Drechsler (1934) defined the genus *Cochliobolus* in terms of teleomorphic and anamorphic forms, and used the concept that the conidial state was an important criterion in helping distinguish it from *Ophiobolus*. He showed that *Ophiobolus* species were connected with *Phoma*-like anamorphs, and that *C. heterostrophus* and congeneric species were connected with conidial forms in *Helminthosporium* sensu lato (*Bipolaris*). By the same reasoning, it might be argued that *Cochliobolus* species with *Curvularia* anamorphs cannot be maintained in the same genus as those with *Bipolaris* conidial states, and that a separate ascomycete genus should be established for them.

I once held such a view but now retreat from that position, which emphasized differences in septum structure, to one in which similarities in conidium morphology are given more weight. Thus the wall and septum structure in conidia of *Bipolaris* and *Curvularia* are regarded as fundamentally alike. There is a thin pigmented outer wall, and a thicker hyaline inner wall which takes part in septum formation. In *Curvularia* species the septa are accentuated by a dark band which is attached to the outer periclinal wall. When conidia are fractured under pressure, this 'secondary septum' commonly ruptures centrally but sometimes is carried out of the conidium. If the latter occurs, the similarity of the extruded portion to that produced when *Bipolaris* conidia are treated in the same way is obvious.

Other features highlight the resemblances described above. When *Bipolaris* conidia are mounted in water, the inner wall is much less obvious than in lactophenol, and the cells appear as overlapping circles (Fig. 1). They have often been illustrated in this form by various authors. *Curvularia* conidia mounted in water do not assume this aspect, and the dark septa still appear to be united with the lateral wall. An isolate of *C. protuberata* Nelson & Hodges used in these studies (7788c) gave rise to a hyaline mutant in culture, which produced numerous conidia lacking pigment. When such conidia are viewed in water mounts, there is a striking similarity to distoseptate conidia of *Bipolaris* (Fig. 14). Crushing these hyaline conidia in KOH also reveals their congruity with this coniditon (Fig. 15). It may be noted that conidia of *C. robusta* were described as distoseptate by Kilpatrick and Luttrell (1967).

Accentuated conidial septa are also found in species which undoubtedly belong in *Drechslera*, for example *D. dematioidea* (Bubák & Wrób.) Subram. & Jain, *D. biseptata*, *D. triseptata* (Drechsler) Subram. & Jain, and *D. erythrospila* (Drechsler) Shoem. In conidia of the last-named fungus, the accentuated basal septum often ruptures as described for *Curvularia*, while a normal distoseptate endospore is expelled from an apical split (Fig. 20). Similar variation in a single conidium was noted in *C. inaequalis* (Shear) Boedijn. In *D. triseptata*, the internal wall of some conidia had become constricted at the septa, clearly showing the darkened septum free from the outer wall (Fig. 18).

Although *Bipolaris* and *Curvularia* are obviously similar, I do not believe they should be united as has been suggested (von Arx & Luttrell 1979). Nor do I believe, however, that the differences between them are sufficient to warrant the erection of a separate genus to accommodate the teleomorphs of *Curvularia*. This leaves as the only option a maintenance of the status quo, accepting a certain degree of heterogeneity within the anamorphs of *Cochliobolus* species. This is not without precedent. For example in *Nectria* the anamorphs might be considered variations on the theme of cylindrical phialide, in which increasing complexity of arrangement of conidiogenous cells can be recognized (Samuels & Rossman 1979).

New combinations

Earlier in this paper I proposed that the name *Pseudocochliobolus* be put into synonymy with *Cochliobolus*. The following changes then become necessary.

Cochliobolus nisikadoi (Tsuda, Ueyama & Nishihara) comb. nov.
  Pseudocochliobolus nisikadoi Tsuda, Ueyama & Nishihara, Mycologia 69: 1117, 1977.
Cochliobolus australiensis (Tsuda & Ueyama) comb. nov.
  Pseudocochliobolus australiensis Tsuda & Ueyama, Mycologia 73: 92, 1981.

I shall show in a subsequent paper that *Bipolaris* and *Drechslera* should be maintained as separate taxa. *Drechslera chloridis* Alcorn is the only *Cochliobolus* anamorph to which a binomial has been applied (Table 1), and which is now considered misplaced. The necessary new combination is:

Bipolaris chloridis (Alcorn) comb. nov.
  Drechslera chloridis Alcorn, Trans. Br. mycol. Soc. 67: 148, 1976.

In addition, the combination *B. homomorphus* (Luttrell & Rogerson) Subram. (Subramanian 1971) was not validly published (Art. 33, basionym not indicated). This ommission is corrected here.

Bipolaris homomorphus (Luttrell & Rogerson) Subram. ex Alcorn
Helminthosporium homomorphus Luttrell & Rogerson, Mycologia 51: 195, 1959.

A LECTOTYPE FOR *COCHLIOBOLUS HETEROSTROPHUS*

A specimen labelled as the type was obtained from BPI. The label details agreed with those cited by Drechsler (1925):

> *Cochliobolus heterostrophus* (Drechs.) Drechs. on *Zea mays*
>
> Sanford, Fla. Sept. 22, 1923
> Coll. A.C. Foster
> Det. Charles Drechsler

An inner packet contains approximately 24 leaves or leaf segments. They are quite narrow, and very thin, suggesting that they originated from seedlings. Numerous lesions typical of infection by *C. heterostrophus* are present on the leaves, but a thorough search of all the material revealed no ascocarps, and only very scanty conidial sporulation. Twenty-seven other collections from BPI labelled *C. heterostrophus* were examined, but no ascigerous state was detected. No slides from the type showing the ascal state are preserved in BPI (M. Stransky, pers. comm. 1977), and it therefore appeared that a neotype would have to be selected to typify *C. heterostrophus*. Fortunately, ascal material identified by Drechsler is available. In a paper in which the new genus *Pseudocochliobolus* was established, Tsuda et al. (1977) referred to a specimen of *C. heterostrophus* from BPI in a manner suggesting that ascal material had been seen. This was confirmed in correspondence (Tsuda, pers. comm. 1978), and subsequently the specimen was obtained from BPI. The typed outer label bears the data:

> *Cochliobolus heterostrophus* Drechsler on *Zea mays*
>
> Washington D.C. Oct. 7, 1924
> Coll. & Det. Charles Drechsler

A handwritten inner label shows that the original name given was *Ophiobolus heterostrophus*, that the host is 'Philippine corn leaf', and that it was incubated in a damp chamber for 30 days beginning Oct. 7, 1924. This is some of the material collected in the Philippines in November 1921 and referred to by Drechsler in his account of *O. heterostrophus* (Drechsler 1925, p. 707). The specimen consists of the contents of three moist chambers, made up on 9 cm diam. filter papers. There are seven leaf segments in all, each 6-7 cm long, darkened by fungal colonies and bearing ascocarps visible without magnification. The ascocarps are black, scattered, amphigenous, erumpent, mostly with a prominent cylindrical to conical beak and often with brown setae or hyphae over the upper half of the body but not on the neck. Three ascocarps were examined. They were 460-520 µm high x 360-400 µm diam., with the beak 140-160 µm high, 90-110 µm diam. at the base and 60-100 µm at the apex. Asci were obclavate to cylindrical, with a short pedicel, and measured 132-165 x 22.5-30 µm. Ascospores were not released from the asci when the ascocarps were dissected in a drop of water, so measurements of length were not possible. They were closely coiled in the ascus, hyaline to faint yellowish brown, multiseptate, and 5-10 µm diam. As reported by Tsuda et al. (1977), there was no evidence of stromatic tissue at the base of the ascocarps. Conidia on the specimen were similar to those on 28 other collections of *C. heterostrophus* in BPI examined previously.

The specimen described above is designated as the lectotype for *Cochliobolus heterostrophus*, the generic type, in order that this important species may be properly typified.

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TREMELLALES OF ISRAEL

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ABSTRACT

Nine taxa of tremellaceous fungi growing mainly with oak and pine trees, are described. They were found in the Galilee and the central parts of the country and eight of them are new records for Israel.

INTRODUCTION

The Agaricales of Israel have already received attention (Binyamini, 1977, 1980 and Moser, Binyamini & Avizohar-Hershenzon, 1977), but information about the Tremellales of Israel has, until now, been neglected. There is neither a flora, nor are there monographic studies of the tremellaceous fungi covering the study area around Israel. The nearest area is Greece, as exemplified in the Fungus Host Index of Pantidou (1973).

Owing to its geographical dry climate, Israel has a relatively few tremellaceous resupinate fungi. This report is concerned with 9 taxa, of which 8 are newly recorded for Israel. Most of the collections upon which this report is based were made during the period 1974-1981/2. Some of the examined specimens show slight differences compared with European material, possibly because of the dry climatic conditions, and consequently, it was deemed worthwhile to provide at least a short description of the species in our collections.

One species listed has already been recorded by Rayss & Reichert (1952). The systematics of the families and genera follow Martin (1952) and Lowy (1971). The source of each record is indicated at the end of the description and the herbarium numbers are given in parentheses. The colours specified in parentheses are taken from Kornerup & Wanscher (1967). Microscopic structures were observed on fresh material. All collections cited have been deposited in the herbarium of the Department of Botany, Mycology Division, Tel Aviv University.

TREMELLACEAE

Exidia glandulosa Fr., Syst. Mycol. 2 : 224.1882 Fig. 1

Fruit body firm gelatinous, dark brownish, becoming black, glistening when dry; hymenium smooth to tuberculate. Flesh blackish. Hyphae with clamp connections; probasidia ovate or elliptical, 10-16 x 8-14 µm, becoming cruciate-septate, spores hyaline, allantoid, 10-15 x 4-5 µm.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Ha'arbaim Wood, 9.2.81 (81p137), Upper Galilee, Bar'am Wood, 3.2.81 (81p460), Hiram Wood, 3.2.81 (81p451, 81p452).

Our specimens conform well with the descriptions of Martin (1952) and Lowy (1971).

Exidia nucleata (Schw.) Burt, Ann. Missouri Bot. Gard. 8 : 371.1921. Fig. 2

Fruit body cerebriform, gelatinous, whitish becoming brown with pinkish tinge to brown vinaceous with whitish granules; hymenium smooth. Hyphae with clamp connections; probasidia ovate, 10-12 x 6-8 µm, cruciate-septate, epibasidia subcylindrical up to 60 x 3.5-4.5 µm, spores hyaline, 8-11.5 x 4-4.5 µm, cylindrical curved, germinating by repetition.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Bet Oren S. 29.12.80 (80p117, 80p151), Ha'arbaim Wood, 9.2.81 (81p138). Upper Galilee, Bar'am Wood, 3.2.81 (81p130), on dry branch of *Calycotome villosa*, Hiram Wood, 3.2.81 (81p139).

The white colour which changes through brown pinkish to brown vinaceous is characteristic of our specimens, and conform well with the descriptions of Martin (1952) and Lowy (1971).

Exidiopsis effusa (Bref. ex Sacc.) A. Möller, Fig. 3
Bot. Mitth. Tropen 8 : 82.1895

Fruit body soft gelatinous, greyish hyaline to nearly chalk white; hymenium finely granulose, smooth < 100 µm, thick. Hyphae with clamp connections; dikarioparaphyses subcylindrical branched, forming a thin layer above the basidia; probasidia ovoid to subglobose, 10-15 x 8-10µm, clamps at the base, epibasidia four, up to 40 x 4 µm, spores cylindrical curved to allantoid, 12-15 x 4-5 µm, germinating by repetition.

Habitat. On dry branch of *Quercus*, Mt. Carmel,,Ha' arbaim Wood, 9.2.81 (81p280, 81p281, 81p284, 81p389). On dry branch of *Rhamnus*, Upper Galilee, Bar'am Wood, 3.2.81 (81p431).

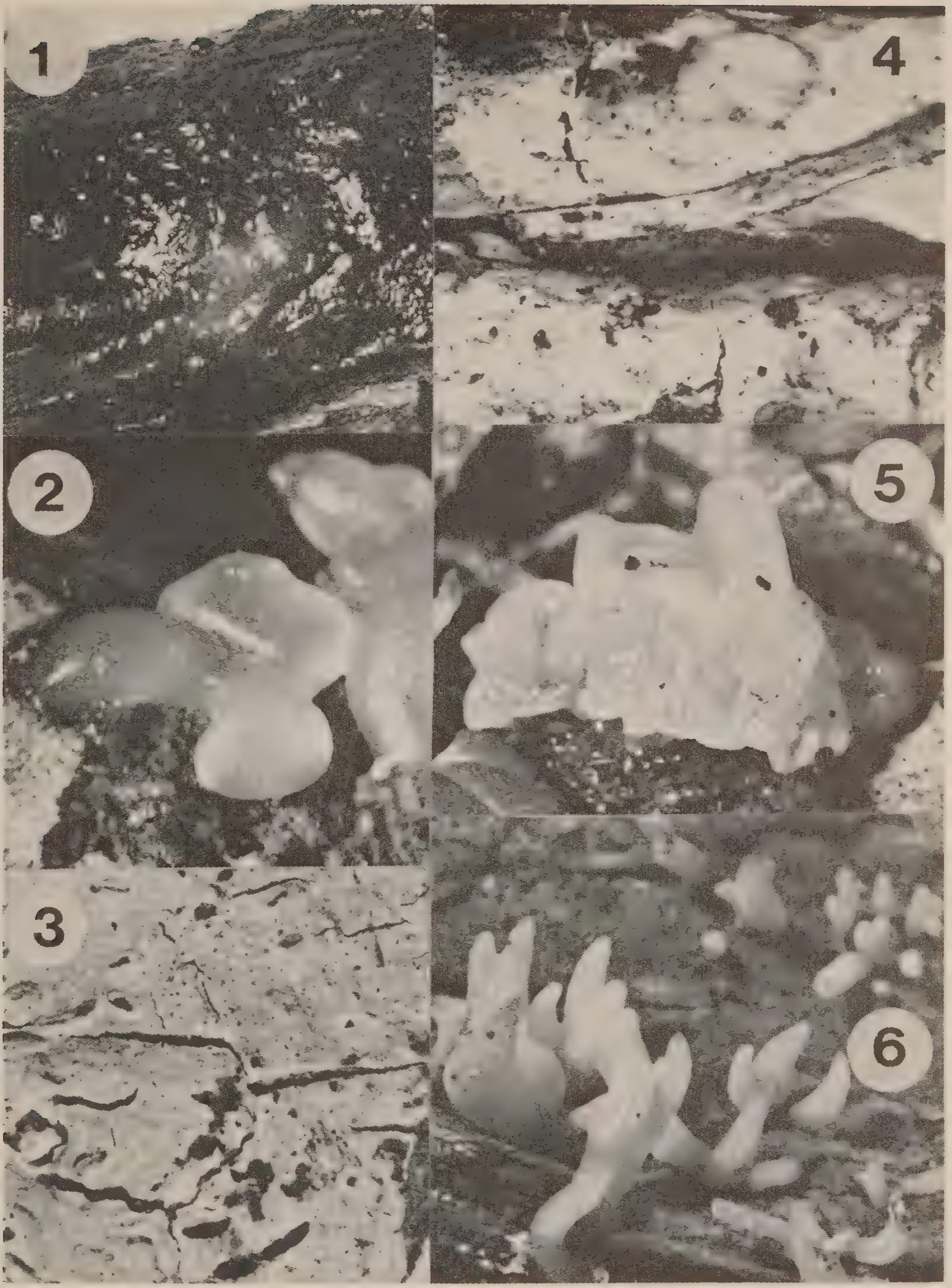
The effused gelatinous greyish-white basidiome, with branched dikaryoparaphyses and larged curved spores is characteristic of our specimens. Spores are slightly snaller than those described by Lowy (1971) and Wells & Raitviir (1977), but close to those of Christiansen (1959) and Reid (1970). According to Wells (1961), *E. effusa* is a synonym of *E. grisea* (Pers.) Bourd. & Maire, but Wells & Raitviir (1977) agree that *E. effusa* is very closely related to *E. grisea* and that the differences in substrate, colour of dry specimens and spore size differentiate the two taxa.

Sebacina incrustans (Fr.) Tul., Jour. Linn. Fig. 4
Soc. Bot. 13 : 36. 1871.

Fruit body fleshy coriaceous, up to 1 mm thick, cream-yellow (4C3, 4C2, 4B2), margin slightly fibrillose. Hyphae without clamp connections; probasidia subglobose, becoming cruciate-septate, 15-20 x 11-13 µm, epibasidia 30-75 x 2.5-3 µm, spores ovate to oblong, with lateral apiculus, 10.5-15 x 5.5-7 µm, germinating by repetition.

Habitat. On dry branch of *Pinus*. Ramot Menashe, Goara, 3.3.81 (81p221).

The resupinate, cream-yellow fruit body, and large, ovate spores characterise our specimens; in these respects the collection conforms well to the descriptions of Martin (1952), Christiansen (1959) and Lowy (1971).



Figs.1-6. 1. *Exidia glandulosa* x5. 2. *E. nucleata* x4. 3. *Exidiopsis effusa* x5. 4. *Sebacina incrustans* x4. 5. *Tremella mesenterica* x2. 6. *Calocera cornea* x4.

Tremella fimbriata Fr., Syst. Mycol. 2 : 212, 1822.
= *T. foliacea* Fr., Syst. Mycol. 2 : 212. 1822.

Fruit body leaf-like folds, gelatinous, cinnamon-brown, becoming vinaceous black on drying. Hyphae with clamp connections; probasidia subglobose, becoming cruciate-septate, 12-18 x 10-15 µm, epibasidia up to 70 µm, spores subglobose-ovate, 8-9 x 5-7 µm, germinating by repetition.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Bet Oren S. 20.1.81 (81pl22).

Our specimens were slightly dry when found, but the microscopic characters, such as clamped hyphae and spores, all conform well to the descriptions of Martin (1952) and Lowy (1971).

Tremella mesenterica Fr., Syst. Mycol. 2 : 214 1822. Fig. 5
= *T. lutescens* Fr., Syst. Mycol. 2 : 213. 1822.

Fruit body cerebriform to lobate, usually large, < 10 cm in length, gelatinous, orange, or golden yellow. Hyphae with clamp connections; probasidia subglobose, becoming cruciate-septate, 10-17 x 8-14 µm, epibasidia up to 75 µm, spores subglobose to ovoid, 10-14 x 8-12 µm, germinating by repetition.

Habitat. On dry branch of *Quercus*. Upper Galilee, Bar'am Wood, 23.1.72 (72pl52), 9.3.81 (81p209), Mt. Carmel, Bet Oren S., 29.12.80 (80pl18), 17.1.82 (82pl03).

This, our commonest large *Tremella*, is frequently found on dry branches and trunks of oak. Lowy (1971) supports the interpretation of considering *T. mesenterica* Fr. and *T. lutescens* Fr. to be a single variable species.

DACRYMYCETACEAE

Dacrymyces deliquescens (Mérat) Duby, Bot. Gall. 729. 1829.

Fruit body lenticular, up to 5 mm, gelatinous, orange-yellow or pallid (4B6), becoming reddish brown on drying, smooth. Hyphae with clamp connections, smooth or rarely roughened; probasidia subclavate, 30-50 x 4-6 µm, epibasidia bifurcate, up to 15 x 3 µm, spores allantoid, becoming 3 septate, 14-16 x 5-6.5 µm.

Habitat. On dry branch of *Quercus*, Mt. Carmel, Ha'arbaim Wood, 9.2.81 (81p135, 81p286). On dry branch of *Pinus*, Bet Oren, 9.2.81 (81p141, 81p169).

The lenticular or sometimes flattened orange-yellow fruit body, with bifurcate epibasidia and large allantoid septate spores are characteristic for our specimens and conform well to the description of Martin (1952).

Calocera cornea (Batsch ex Fr.) Fr., strip. Fig. 6
Agri. Tems. 67. 1826.

Fruit body gelatinous to tough, narrowly club-shaped, unbranched or very sparsely branched above, round in cross-section, up to 15 mm high and 1 mm thick, pale yellow or orange-yellow; hymenium smooth. Probasidia subclavate, 35-40 x 2.5-5 µm, spores cylindrical, curved, 8-10 x 3-4.5 µm.

Habitat. Scattered to gregarious, usually two to three clustered together. Upper Galilee, Pa'ar Cave, on dry branch and trunk of *Quercus*, 25.1.72 (72p505), 3.2.81 (81p129).

This small and beautiful species is variable in its colour, size and degree of branching. The reddish tinge on drying, which is described by Martin (1952) and Lowy (1971), is not clear in our specimens.

AURICULARIACEAE

Auricularia auricula(Hooker) Underwood in Barrett,
Mycologia 2 : 12. 1910.
= *Hirneola auricula-judae* Berk., Outl. Brit. Fung.
298. 1860.

Habitat. On cut trunk of *Ficus*, Mique Izra'el 28.11.74 (74p106), 26.2.74 (74p104), 12.1.77 (77p113), Hulda, 8.2.75 (75p105), Ramat Hasharon, 1.9.78 (78p126).

This species has already been encountered in Israel and described by Rayss and Reichert (1952). It has been found several times; it is common each year.

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A NEW JAPANESE SPECIES OF *NEOCOSMOSPORA* FROM MARINE SLUDGES

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Since 1899 when E. F. Smith established the genus *Neocosmospora* with *N. vasinfecta* as the type, a total of 5 species and 3 varieties has been described (Mahoney, 1976; Domsch et al., 1980). Only one of these, *N. striata* Udagawa et Horie (1975), has ascospores covered with 8-10 transverse crests. A second member of *Neocosmospora* with striate ascospores was isolated during a continuing survey of the polluted fungi of Nagasaki Prefecture, Japan (Ueda, 1981). In this paper a new species based on the isolate is described and the major differences distinguishing the species from *N. striata* are presented. The specimen studied is preserved at the Mycological Herbarium, National Institute of Hygienic Sciences, Tokyo (NHL).

Neocosmospora tenuicristata Ueda et Udagawa, sp. nov. (Figs. 1-12)

Stat. Anam. *Acremonium tenuicristatum* Ueda et Udagawa, anam. sp. nov.

Coloniae in agaro cum decocto tuberorum et dextroso celeriter crescentes, funiculosae, tenues, vinaceo-bubalinae; perithecia abunde producentia, persicina vel badia, cum hyphis aeriis et conidiis albis obtecta; reversum brunneum vel brunneo-aurantiacum vel hinnuleum.

Perithecia superficialia, dispersa vel aggregata, rubro-brunnea, ovoidea vel pyriformia, 335-415 × 265-320 µm, glabra vel parce pilosa; pili hyalini vel dilute flavi, non ramosi, septati, leves, breves, hyphoidei, 6-8 µm diam; perithecii collum breve, conicum plus minusve valde rubro-brunneum, 65-80 × 80-115 µm, glabrum; peridium membrana-

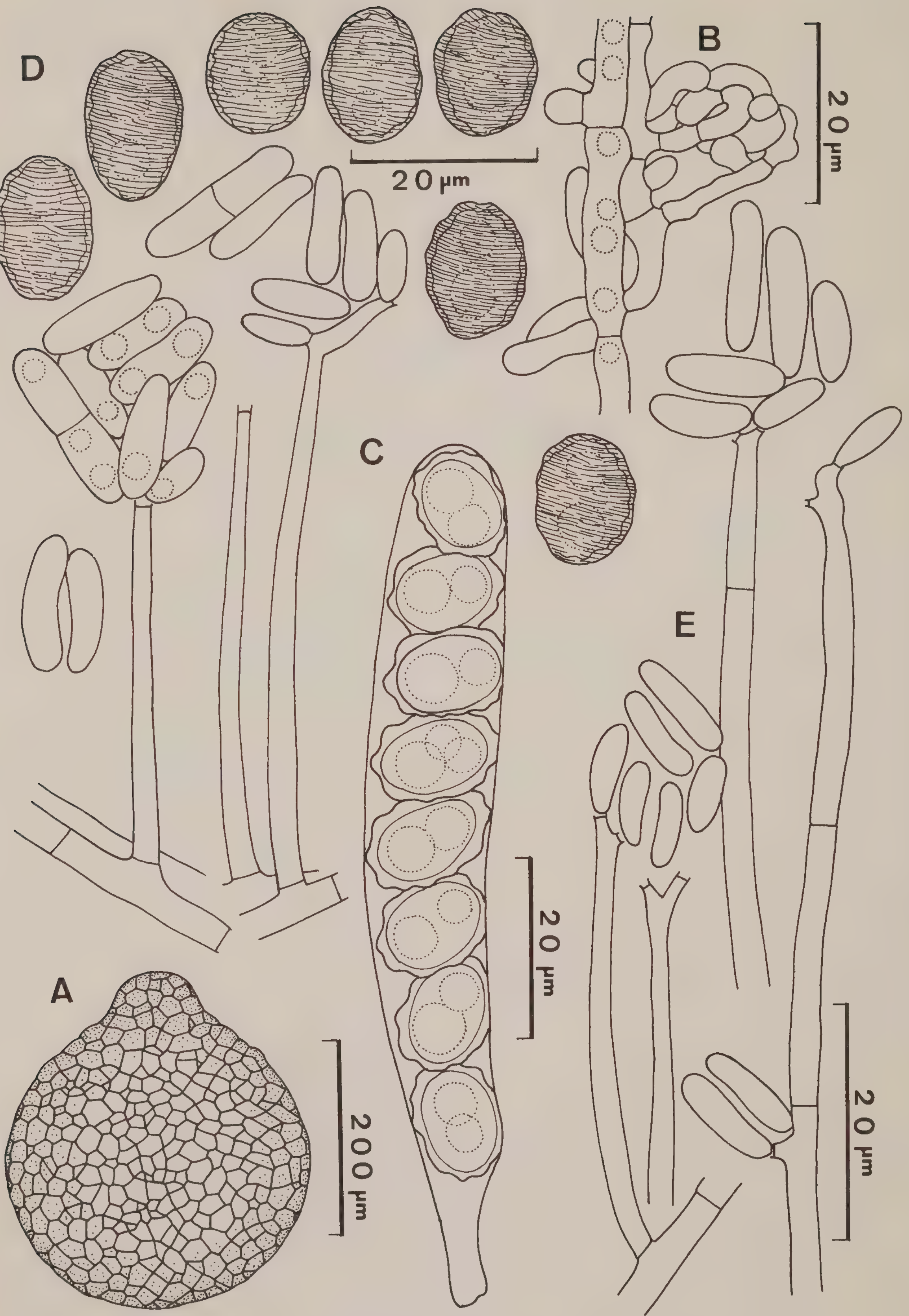


Fig 1. *Neocosmospora tenuicristata*, NHL 2911. A. Perithecium. B. Perithecial initial. C. Ascus. D. Ascospores. E. Conidia-bearing structures and conidia.

ceum, pseudoparenchymaticum, dilute flavo-aurantiacum, saepe semitranslucens, 'textura angularis'; stratum exterius e cellulis dilute salmoneis, incrassatis, angularibus, 10-32 × 10-22 µm compositum; stratum interius e cellulis hyalinis, tenuibus, complanatis, angularibus compositum; periphyses hyalinae, filiformes, septatae, non ramosae, ad basim 3-4 µm diam, ad apicem rotundatae. Asci octospori, hyalini, cylindracei, 90-110 × 13-15 µm, superne rotundati vel aliquantum truncati, sine poro apicali instructi, breviter stipitati, in fasciculo basali dispositi. Ascosporae uniseriatae, unicellulares, flavo-brunneae, late ellipsoideae vel ellipsoideae, 13.5-17 × 10-11.5 µm, guttulatae, incrassatae, sine poro germinali instructi, subtiliter et transverse striatae.

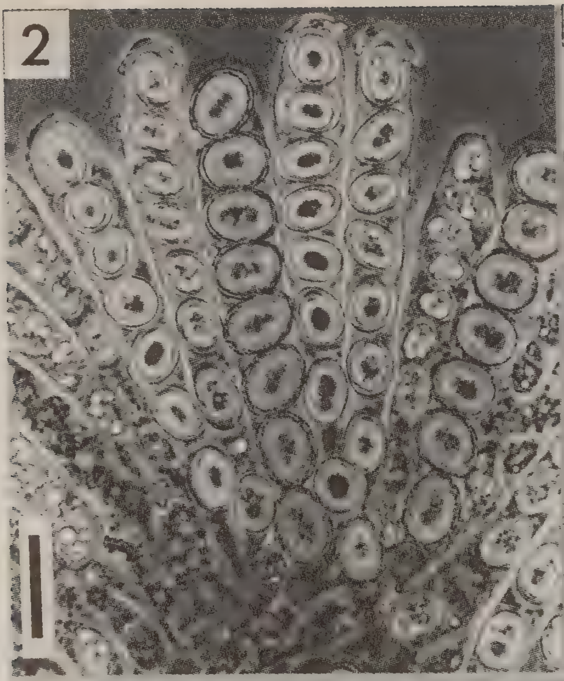
Mycelium e hyphis hyalinis vel dilute flavo-brunneis, ramosis, septatis, levibus, 1.5-10 µm diam, saepe in funiculo aggregatis compositum. Conidiophora brevia, plerumque 15-35 × 3-5 µm, hyalina, non ramosa vel pauci-ramosa, levia, septata, erecta, e mycelio vegetativo vel funiculis hypharum et hyphis aeriis orientia, mononemata. Cellulae conidiogenae monophialidicae vel polyphialidicae, plerumque simplices sed interdum sympodice proliferae vel percurrentes, terminales, saepe in conidiophoris incorporatae, rectae, hyalinae, 30-50(-125) × 2.5-4 µm, superne gradatim attenuatae, collari parvo praedita. Conidia hyalina, guttulata, 0-1-septata, ellipsoideo-cylindracea vel fusiformia, parum incurvata, 6.5-15(-19) × 2.5-4.5 µm, levia, utrinque rotundata, in massa mucida aggregata. Chlamydosporae absunt.

Holotypus: cultura NHL 2911 ex limo (marine sludge), Nagasaki in Japonia, in 26.i.1981, a S. Ueda, isolata. In collectione fungorum 'National Institute of Hygienic Sciences (NHL), Tokyo, Japan'.

Etymology: lat. *tenui-* = thin and *cristatus* = crested, referring to the nature of the ascospore ornamentation.

Colonies on potato-dextrose agar spreading broadly, attaining a diameter of 8.0 cm in 2 weeks at 23 C, funiculose, consisting of a thin mycelial felt, Vinaceous Buff (Rayner, 1970) in color; perithecia abundantly produced on the felt, Peach or Bay (Rayner, 1970), covered loosely with white aerial hyphae and conidia; reverse brown to brownish orange or Fawn (Rayner, 1970).

Perithecia superficial, scattered or aggregated, at first flesh-colored, then becoming pale pink or orange-red, finally reddish brown, ovoid to pyriform, 335-415 × 265-320 µm, glabrous or sparingly covered with hyaline to pale yellow, unbranched, septate, smooth-walled, short, hyphal-like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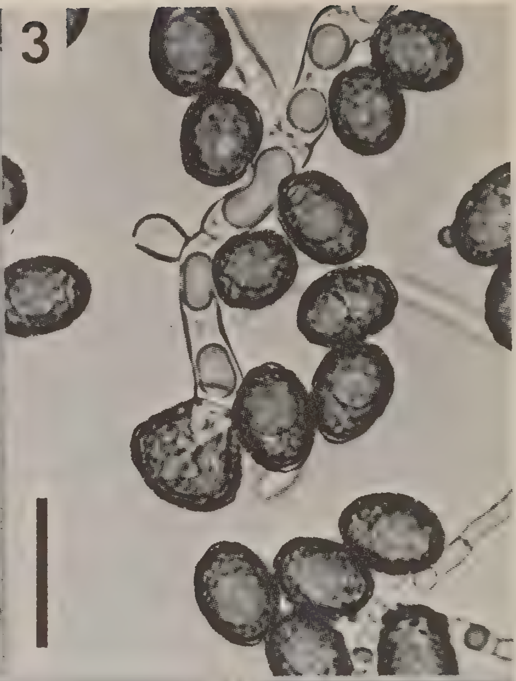
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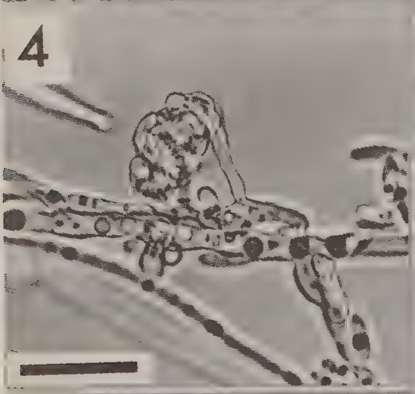
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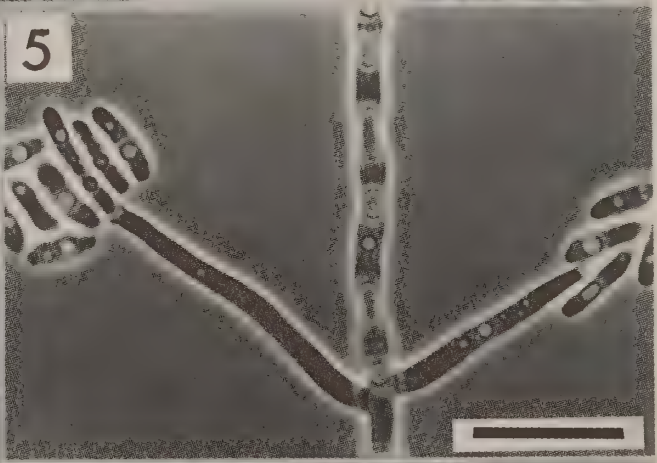
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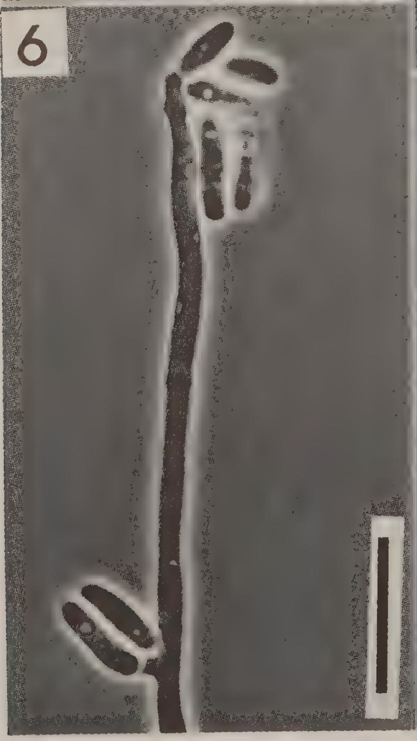
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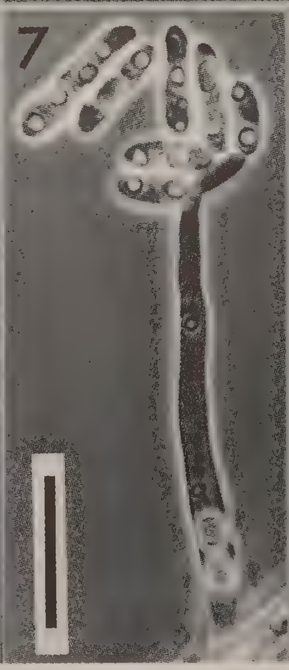
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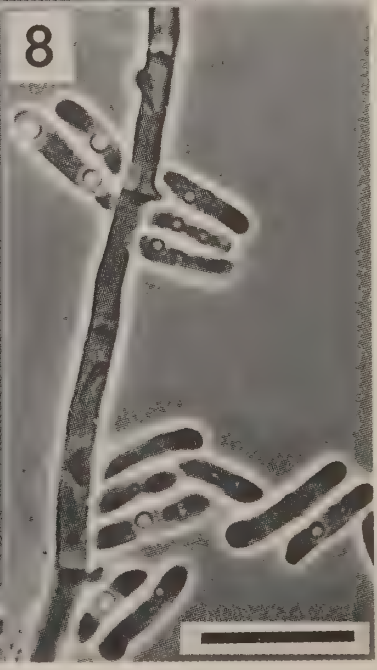
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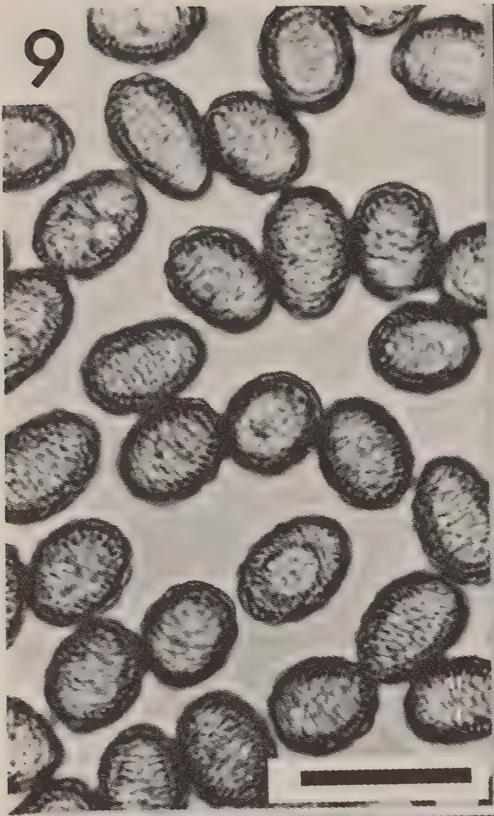
hairs measuring 6-8 μm in diam; neck short, conical, more or less dark reddish brown, 65-80 × 80-115 μm, glabrous, at the ostiole region composed of short, cylindric cells; peridium membraneous, pseudoparenchymatous, pale yellowish orange, often semitransparent, textura angularis; outer layer composed of pale salmon-colored, thick-walled, angular cells measuring 10-32 × 10-22 μm; inner layer of hyaline, thin-walled, flatten, angular cells; periphyses hyaline, filiform, septate, unbranched, 3-4 μm in diam at the base, tapering to a rounded tip. Asci 8-spored, hyaline, cylindric, 90-110 ×13-15 μm, rounded or somewhat truncate above, without distinct apical structure, short-stalked (stipe: up to 20 μm long), borne in a basal fascicle. Ascospores uniseriate, one-celled, yellowish brown, broadly ellipsoid to ellipsoid, 13.5-17 × 10-11.5 μm, guttulate, thick-walled, without germ pore, with surface ornamented by very fine ridges which are roughly transverse and wavy in appearance, extruded at maturity in the form of a gelatinous mass; epispore ca. 1.5 μm thick.

Mycelium composed of hyaline to pale yellowish brown, branched, septate, smooth-walled hyphae 1.5-10 μm wide, often aggregated in funicles. Perithecial initials arising as coiled or contorted side branches of hypha, then becoming surrounded by hyphae arising from the neighboring cells. Conidiophores short, usually 15-35 × 3-5 μm, hyaline, unbranched or a few branched, smooth-walled, septate, arising directly from the vegetative mycelium or hyphal ropes and aerial hyphae, mononematous. Conidiogenous cells monophialidic or polyphialidic, usually simple but sometimes proliferating sympodially or percurrent, terminal, integrated, straight, hyaline, 30-50(-125) × 2.5-4 μm, tapering gradually to the minute apical collarette measuring 2-2.5 × 1.5-2 μm; phialides sometimes reduced to a collarette on the hypha. Conidia hyaline, guttulate, 0-1-septate, ellipsoid-cylindric or fusiform, slightly incurved, 6.5-15(-19) × 2.5-4.5 μm, smooth-walled, rounded at both ends, aggregated in a slimy mass measuring 7.5-18 μm in diam. Chlamydospores absent.

At 37 C, growth is slightly slower that at 23 C and perithecial production is reduced.

Specimen examined: an isolate from marine sludge, at Oomura Bay, Higashisonogi-gun, Nagasaki-pref., Japan, Jan.

Figs. 2-8. *N. tenuicristata*, NHL 2911.
2. Asci. 3. Ascospores, showing germination. 4. Perithecial initial. 5-8. Conidia-bearing structures and conidia. The line in all figures equals 20 μm.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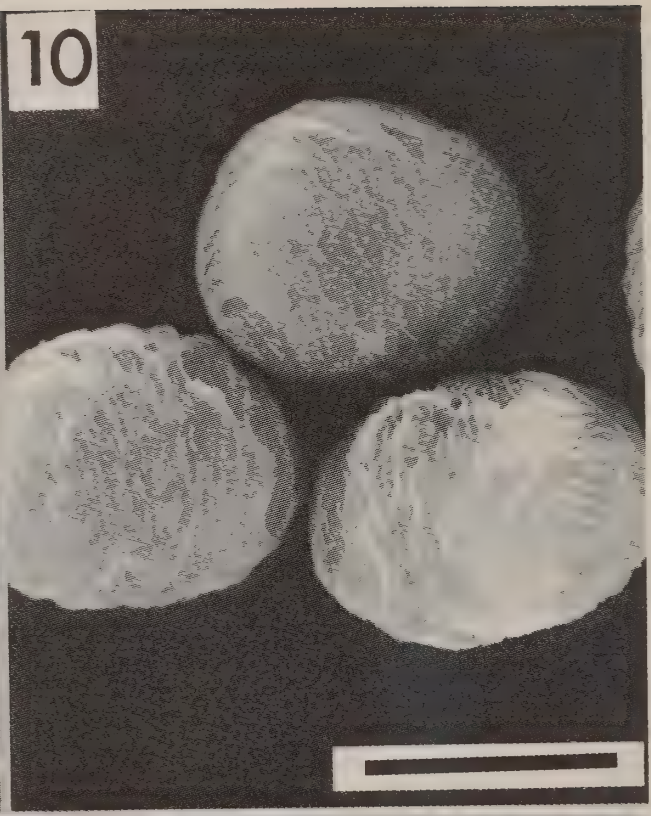
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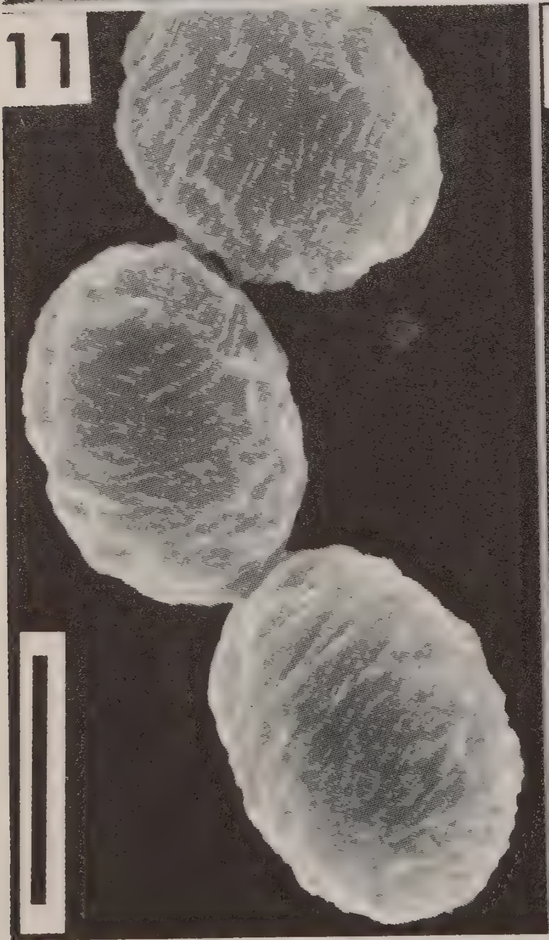
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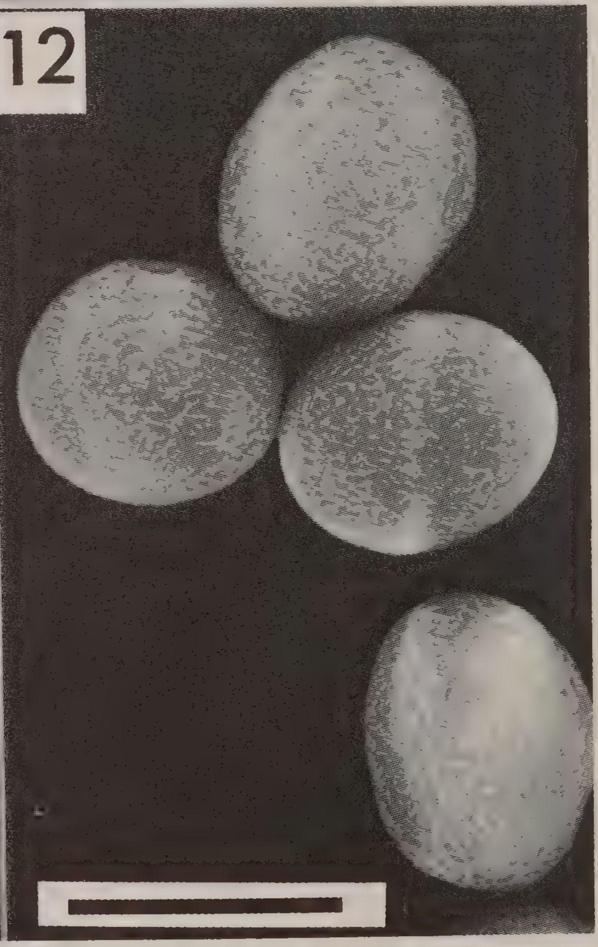
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26th, 1981, S. Ueda, NHL 2911, holotype. Subculture of NHL 2911 has been deposited with the American Type Culture Collection (ATCC).

Neocosmospora tenuicristata, with its striate ascospores and polyphialidic anamorph, is unique in its genus. In the ascospore ornamentation, it has a strong resemblance to *N. striata* Udagawa et Horie (1975), which differs by having smaller perithecia with a cylindric neck, irregular-elongate cells of the peridium in place of angular-shaped cells, smaller asci and ascospores which are ornamented with more rugged 8-10 transverse crests, and the absence of anamorph. According to van Warmelo's SEM study (1976), the patterns of surface ridges of ascospores in *N. vasinfecta* and *N. africana* von Arx appeared to be quite similar. The ascospore ornamentation in both species consists of a network of anastomosing ridges over the surface, while the ridges in *N. tenuicristata* are clearly separate as revealed by SEM observation (Figs. 10-12) as well as examination with the light microscope.

Another interesting point in *N. tenuicristata* is its anamorphic characters. There are a few species such as *A. hyalinulum* (Sacc.) W. Gams and *A. brunnescens* W. Gams in the form-genus *Acremonium* (Gams, 1971, 1975) having proliferation of phialides (polyphialides). Both *Acremonium* are distinguished from the anamorph of *N. tenuicristata* by their small (not exceeding 7 µm in length and 2.5 µm in width) and catenated conidia, as well as by very slow-growing fine mycelia. For the anamorph of *N. vasinfecta*, Domsch et al. (1980) stated that "*Cephalosporium*-like, but as the colonies grow fast and the hyphae are wide, it recalls the micro-conidial states of *Fusarium* rather than *Acremonium*." In fact, the growth-rate on usual media, and the features of vegetative mycelium and conidiogenous structures in *N. tenuicristata* are similar to those of *Fusarium proliferatum* (Matsushima) Nirenberg in the sect. *Liseola*. Matsushima (1971) firstly described *Cephalosporium proliferatum* as follows: Phialophora ex hyphis repentibus vel aeriis ascendentia, simplicia vel ramosa, usque ad 100 µm alta, 2-4 µm crassa, rami terminales fertilia, sym-

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Figs. 9-11. *N. tenuicristata*, NHL 2911, and Fig. 12. *N. africana* von Arx, No. 78-S-35-10.
9. Ascospores with light microscopy. 10-12. Ascospores with scanning electron microscopy, showing their difference in surface ornamentation. The line in Fig. 9 represents 20 µm; in Figs. 10-12 equals 10 µm.

podialiter sub apice proliferascentia et polyphialidibus geniculatis formata. Conidia of *C. proliferatum* are more or less clavate, one-celled, 5-11 × 2-4 µm, and with a truncate base. Matsushima failed to observe the macroconidia on his material of *C. proliferatum*, but after comparing with 46 isolates of *Fusarium moniliforme* Sheld. sensu Wollenw. et Reinking pr. p., Nirenberg (1976) concluded that pyriform conidia of both are conspecific and transferred *C. proliferatum* to the genus *Fusarium*. The anamorph of *N. tenuicristata* differs from *F. proliferatum* in having broader mycelium, larger ellipsoid-fusiform conidia with rounded ends and in the absence of macroconidia.

Since the conidia of the previous *Neocosmospora* species have usually been placed in *Acremonium* or *Acremonium*-like genera, the anamorph of *N. tenuicristata* seems to be better treated as *Acremonium* until the discovery of its associated macroconidia. However, the occurrence of polyphialidic structures further emphasizes the affinity of anamorphs of this and other *Neocosmospora* to *Fusarium*.

ACKNOWLEDGMENT

Appreciation is expressed to Dr. S-C. Jong, American Type Culture Collection, for reviewing the manuscript.

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NEW RECORDS OF HYPOGEOUS ASCOMYCETES IN ARIZONA

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SUMMARY

The following hypogeous ascomycetes are reported as new records for Arizona, USA: *Balsamia magnata, Elaphomyces verrucosus, E. granulatus, Geopora cooperi* f. *cooperi, G. cooperi* f. *gilkeyae, Tuber dryophilum,* and *T. levissimum.* All species are putative mycorrhizal symbionts with *Pinus ponderosa* Laws. They were major food items in the diet of the tassel-eared squirrel, *Sciurus aberti.*

A nearly pure stand of *Pinus ponderosa* Laws. covers 7.5 million acres in northern Arizona and western New Mexico. The tassel-eared squirrel, *Sciurus aberti* Woodhouse, and its various subspecies (Hofmeister and Diersing, 1978), are closely associated with this conifer. Citing a close dependence on ponderosa pine for food and shelter, Keith (1965) and Hall (1981) point out a restricted distribution of tassel-eared squirrels to the southwestern United States and northern Mexico, with particular abundance in Arizona and New Mexico.

Stephenson (1975) in a study of the food habits of tassel-eared squirrels in northern Arizona, noted that fungi are a major component in their diet throughout most of the year, but he did not attempt to identify the species involved. Upon examination of the spores in the stomach contents provided by Stephenson, I determined that the majority of the fungi consumed were hypogeous species, both ascomycetes (truffles) and basidiomycetes (false truffles). The ascomycete spores were particularly interesting since they represented the genera *Geopora*, *Elaphomyces*, and *Tuber*, all previously unreported from Arizona. Although the squirrels proved to be much more efficient truffle collectors, I have discovered, through my own forays over the past three years, the fruitbodies of the major ascomycete species whose spores are most frequently represented in the squirrel diet.

The hypogeous fungi are little known in the southwestern United States and only occasional collections have been reported, especially in Smith et al. (1981). Fogel and Trappe (1976) have reported the occurrence of hypogeous ascomycetes in the Rocky Mountain region. Some of these are quite similar to those reported here. Nonetheless, I am able to add three additional species in two genera as well as additional host tree associations as presumptive ectomycorrhizae. All species described are new records for Arizona. Collections are deposited in the Deaver Herbarium, Northern Arizona University, and in the herbarium of Oregon State University (OSC).

1. *BALSAMIA MAGNATA* Harkn. *Sensu* Trappe, Mycotaxon 2:119. 1975.

A single collection of three ascocarps match in most respects the description by Gilkey (1916) as *Pseudobalsamia magnata* (Hark.) Gilkey. The very distinctive brownish pink to reddish brown ascocarps measuring 0.5-1.5 cm in diameter made them difficult to detect among the reddish jasper and chert debris of the mineral soil. The verrucae and the occasional small surface depressions of the peridium strongly resembled the surface texture of a russett potato.

ASCOCARPS hypogeous in shallow mineral soil or only slightly imbedded beneath a thin needle layer of *Pinus ponderosa*. Basal tuft and surface opening canals (venae externae) were not clearly evident.

COLLECTION EXAMINED: Coconino County--Jacob Lake, June, elev. 2250 m., States AHF71.

2. *ELAPHOMYCES VERRUCOSUS* Dodge, Ann. Mycol. 27:171-172. 1929.

Species of *Elaphomyces* are difficult to identify. Spore ornamentation as a prime character has been shown to be variable according to conditions of desiccation and developmental stage (Hawker, 1968). The separation of *E. verrucosus* from related species is based primarily on coloration of a marbled peridium when cut in cross section. I have found peridial marbling and the development of surface warts to be inconsistent when comparing different collections. Trappe considers *E. verrucosus* as a synonym of *E. decipiens* (pers. comm.). Until better resolution of this problem is achieved I am satisfied with the present disposition of the collections. The description also fits my collections made in ponderosa pine forests in the Wyoming Black Hills, States WHF14 and WHF32.

ASCOCARPS sphaerical to ovoid, variously depressed when formed near rocky debris; the surface covered by a dense, earthy crust easily separable and composed of *Pinus ponderosa* mycorrhizae and brownish yellow mycelium; peridium yellow or ochraceous, drying yellow brown, verrucose with pointed to rounded yellow warts 90-200 μm high and 100-175 μm wide, hyphal layers strongly to inconspicuously marbled in cross section, when dry 2.0-3.0 μm thick, vinaceous brown with dull rose or rose gray veins interspersed, the layer above the gleba light rose tan; gleba powdery, dark brown to fuliginous; spores globose, 22-28 (31) μm in diameter, ornamentation evenly distributed and densely echinulate, friable after desiccation and easily splitting away from the spore surface when pressed; odor slight or not detectable.

COLLECTIONS EXAMINED: Coconino County--Jacob Lake, June through August, elev. 2250 m., States AHF88, AHF89, AHF117, AHF146, AHF209; Paradise Rd. Flagstaff, States AHF149; Woody Mountain, States AHF103.

3. *ELAPHOMYCES GRANULATUS* Fr., Syst. Myc. 3:58. 1829.

Fogel and Trappe (1976) described *E. granulatus* collected in Colorado among ectomycorrhizae of *Pinus contorta*. The characteristics of our specimen generally follow theirs but some of the special features are listed below.

ASCOCARPS beneath *Pinus ponderosa* litter, deep in mineral soil, associated with a removable soil crust containing pine ectomycorrhizae; peridium smooth, pallid to tawny yellow with faint rusty brown on drying with warts closely appressed as superficial black spots, 3-4 mm thick when fresh and 2-3 mm when dry, tough but cartilaginous and flexible, somewhat viscid when wet, the outer layer in cross section grayish yellow with alternate zones or lenses of brown hyphae in different shades below, the light gray to tan layers above the gleba turn black when cut or bruised; gleba gray brown to dark brown or black at maturity, separating from peridial hyphae as a central powdery mass of spores and hyphae; spores held in globose clusters of eight by an evanescent ascus, globose, 12-22 µm in diameter including ornamentation, the smaller spores dark brown, the larger spores brownish gray to gray, ornamented with crowded spines joined to form small groups of parallel ridges traversing the spores in an undulating pattern, the fragile epispore splitting to reveal a large sphaerical oil droplet imbedded in a gelatinous matrix.

COLLECTIONS EXAMINED: Coconino County--Jacob Lake, June, elev. 2250 m., Lanphear AHF82; Woody Mountain, August, elev. 2190 m., STATES AHF250.

4. *GEOPORA COOPERI* Harkn. f. *COOPERI*, Bull. Calif. Acad. Sci. 1:168. 1885.

This species is likely to be widely distributed in Arizona coniferous forests as indicated by its frequent occurrence in fecal wastes of tassel-eared squirrels. Fogel and Trappe (1976) recorded it from Colorado and I have found it in the Medicine Bow Mountains of Wyoming, States WHF31.

ASCOCARPS hypogeous among ectomycorrhizae of *Pinus ponderosa, Picea angelmanii,* and mixed stands of pine and *Quercus gambelli*. Mostly in exposed sites in rocky mineral soil, May to November, elev. 2100-3300 m.

COLLECTIONS EXAMINED: Coconino County--White Horse Hills, States AHF4; San Francisco Peaks, Snow Bowl ski area, States AHF131; Casner Park, States AHF174; Transition Zone Horticultural Institute near Flagstaff, States AHF175; Hoffderker Hills, States AHF105.

5. *GEOPORA COOPERI* Harkn. f. *GILKEYAE* Burdsall, Mycologia 60:518-519. 1968.

ASCOCARPS were found to be gregarious in deep mineral soil beneath *Pinus ponderosa* and *Pseudotsuga menziesii* litter and surrounded by ectomycorrhizae. The collections fit Burdsall's description who reported it from Colorado and Idaho. I have made collections of both forms of *Geopora* in adjacent locations. Spore size is a constant difference and only in f. *GILKEYAE* was the sporocarp odor pronounced, much like fermented cider. In addition, f. *GILKEYAE* possessed a cream to yellowish tan hymenium whereas the hymenium of f. *COOPERI* was more typically white to light cream in mature specimens.

COLLECTIONS EXAMINED: Coconino County--Woody Mountain, October to November, elev. 2280 m., Lanphear AHF175; Paradise Rd., Flagstaff, States AHF178; Pinal County--Santa Catalina Mountains, September, elev. 2440 m., States AHF242.

6. *TUBER DRYOPHILUM* Tul. Fungi Hypog. 147. 1851.

The discovery of *Tuber* in Arizona is noteworthy because it represents a significant range extension for *T. dryophilum* as well as *T. levissimum* recorded below. A comparison of their striking spore ornamentation is illustrated in Figure 1.

ASCOCARPS hypogeous in mineral soil, 2-6 cm deep with a moderate covering of leaf litter, primordia were noted in mid-August and mature fruitbodies were noted in early December, widely scattered among ectomycorrhizae of *Pinus ponderosa* and *Quercus gambellii*, most abundant on steep south-facing slopes in dense forest stands, rare occurrences were noted beneath alligator juniper (*Juniperus depeanna*), small, 0.5-1.5 cm in diameter, white becoming yellow brown, irregularly subglobose, lightly lobed with white furrows beneath the lobes; peridium variable in thickness, 150-300 (400) µm thick; asci short stipitate when immature, subglobose and persistent as the spores develop, 1-4 rarely 5 spores per ascus; spores globose-ellipsoid to nearly globose, 20-40 x 22-40 (45) µm, bearing prominent alveoli, the ornamentations extending well beyond the spore surface, 3-5 (6) alveoli spanning the greatest diameter, walls and ornamentations becoming rich brown in age.

COLLECTIONS EXAMINED: Yavapai County--Five-mile lake, August, elev. 2150 m., States AHF121; Coconino County--Oak Creek Canyon, August to October, elev. 2080 m. States AHF148, AHF167; Paradise Rd., Flagstaff, August to

December, elev. 2150 m, States AHF162, AHF180.

7. *TUBER LEVISSIMUM* Gilkey, Univ. Calif. Publ. Bot 6:313. 1916.

ASCOCARPS 0.5-1.5 (2.0) cm in diameter, glabrous, smooth texture, bruising tan to light brown, white becoming light yellow brown at maturity, lined with white furrows which extend to the interior as venae externae, contours lobed especially in larger specimens; peridium thin, brown pigmented, 100-250 μm thick, distinctly pseudoparenchymatous becoming hyphal near the glebal cavities; gleba in cross section marbled with tan to gray brown fertile regions contrasting with the white venae; asci subglobose becoming evanescent at maturity with 1-4 dark brown spores; spores subglobose to broadly ellipsoid, alveolate with 5-6 (7) alveoli spanning the diameter of the largest spores, small spores mostly subglobose, 44-53 (62) x 35-45 μm, 3-4 alveoli across the diameter, taste mild and richly mushroom-like.

COLLECTIONS EXAMINED: Coconino County--Paradise Rd., Flagstaff, June to December, elev. 2150 m, States AHF170, AHF181; Casner Park, October, elev. 2200 m., States AHF228.

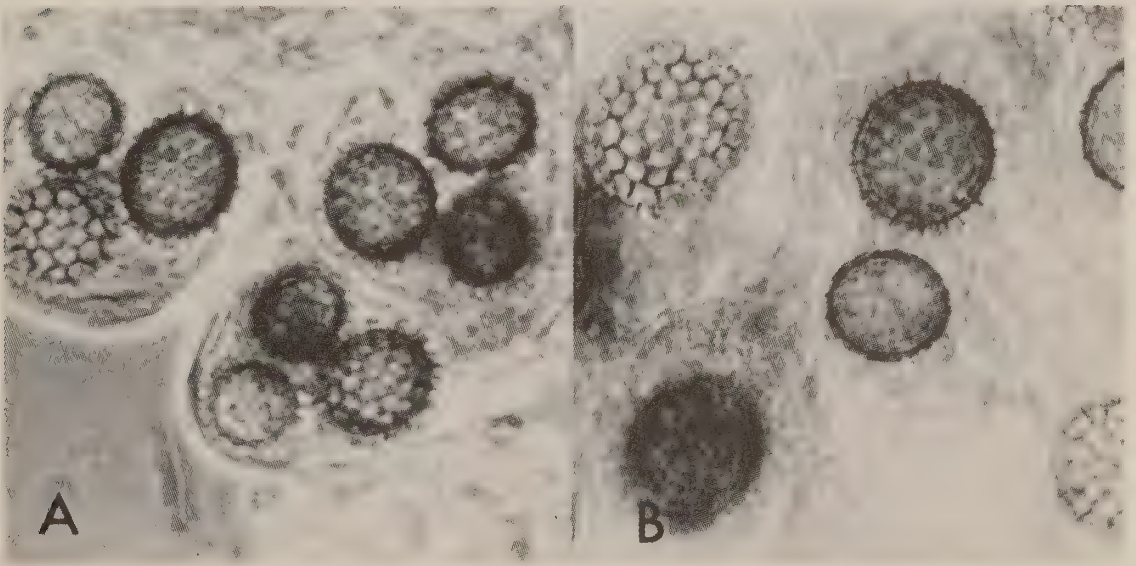

Figure 1. Photomicrographs of *Tuber* ascospores: (A) *Tuber dryophilum* and (B) *Tuber levissimum*, X520.

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STUDIES IN THE GENUS *PHOMA*. I.
PHOMA AMERICANA SP. NOV.

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ABSTRACT

Phoma americana Morgan-Jones and White is described and illustrated from isolates from wheat leaves in Alabama, corn roots in Georgia and cysts of the nematode *Heterodera glycines* Ichinohe in Arkansas, Mississippi and Missouri soils.

PROLOGUS

This being the inaugural number of a series of studies in which taxonomic parameters and species concepts in the genus *Phoma* Saccardo are re-examined.

The generic name *Phoma* has long suffered the ignominious fate of many other commonly encountered genera of the Deuteromycotina by having added to it, largely indiscriminately, a plethora of specific epithets based on such sometimes spurious distinctions as host substrate relationships and miniscule morphological discontinuities. Add to this the fact that many of the contributions to our knowledge of the genus have included descriptions ranging from the mediocre to the moderately competent and we have a recipe for chaos. So much so that a situation has been reached where the application of specific epithets within the genus with confidence can, at best, be a hazardous undertaking.

Over the years the main weakness in the documentation of species peculiarities in the *Phoma*-complex has been a lack of cultural studies under standardized conditions and of adequate accounts of phenotypic plasticity. In *Phoma*, as in such other genera as *Cladosporium* Link and *Fusarium* Link, it has not been merely a matter of interplay between "lumpers" and "splitters". There has long been a dearth of sufficiently adequate information on which to make valid judgements. With the singular exception of the work of Dennis (1946), critical comparative studies *in vitro* of *Phoma* isolates remained unattempted

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until the 1960's when Dr. G. H. Boerema and his co-workers in the Netherlands initiated their far-reaching reassessment of a chaotic taxonomy. Dennis, recognizing the impossibility of defining taxa without linkage with extant type specimens, wisely left in abeyance the matter of speciation choosing instead to classify his isolates into groups of strains. During the last two decades Dr. Boerema has succeeded in doing for *Phoma* what Dr. W. H. Wollenweber did for *Fusarium* some thirty years earlier and we are now in the position to proceed with evolving a satisfactory classification on a sound foundation.

Much remains to be done to fully document the variable expressions of taxa given species rank. As more fresh isolates become available from diverse substrates and ecological niches, in different geographic locations, opportunity arises to increase the data base by which a stable, not to say practical, taxonomy can come into being.

The investigation by Johnston (1981) on fifteen species of *Phoma* occurring on grasses and legumes in New Zealand pastures is exemplary of the type of study which should now be undertaken.

In this series we propose describing in detail strains of *Phoma* originating mainly in the United States.

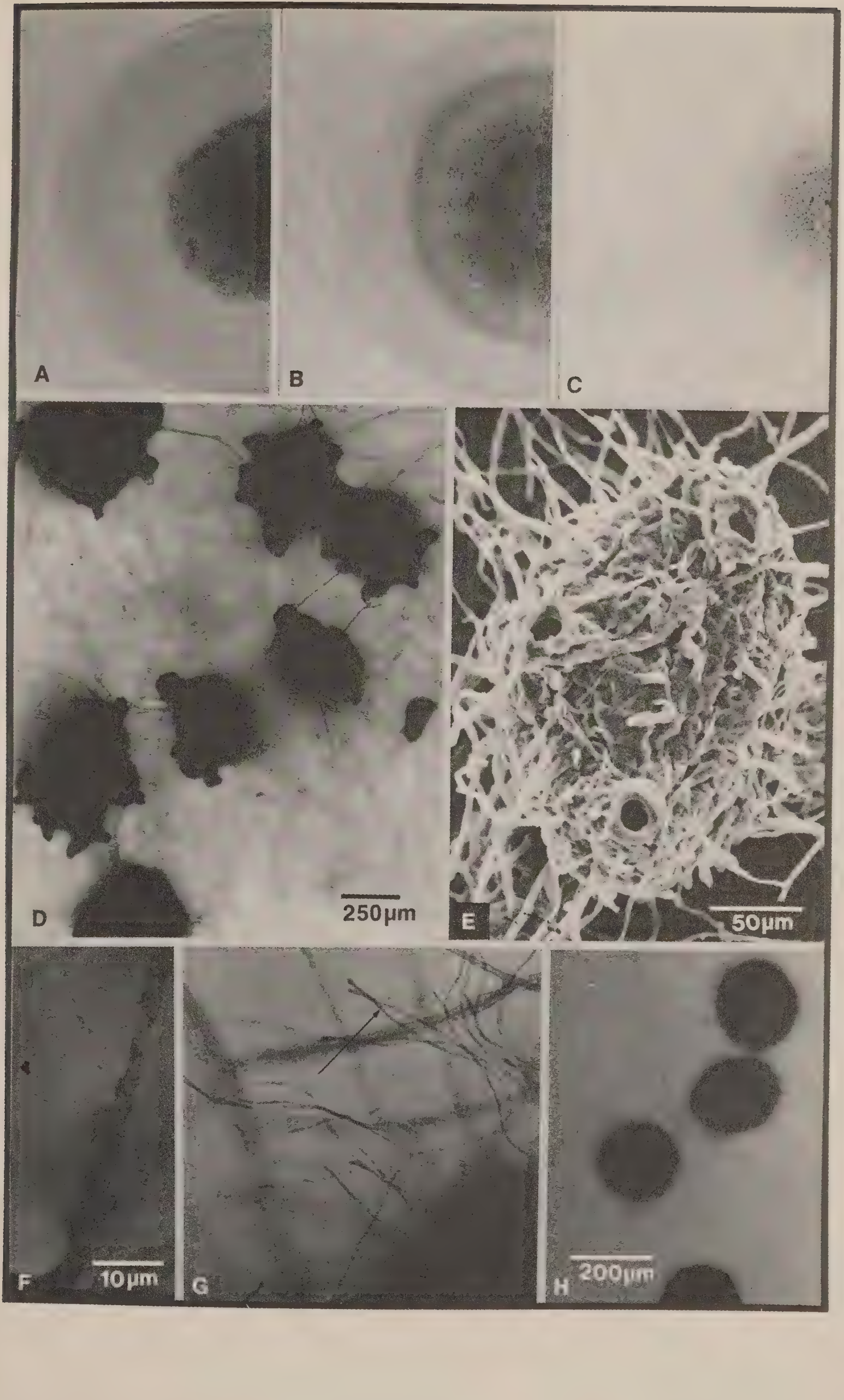
PHOMA AMERICANA - INTRODUCTION

In the course of studying many isolates from various sources we have determined seven strains of *Phoma*, from three diverse substrate origins, to represent a taxon for which no name is currently available in the literature.

The first of these strains examined by us was isolated in the spring of 1981 from leaves of wheat growing in Alabama. The fungus resembled in some respects the plurivorous *Phoma pomorum* Thum. [*Phoma prunicola* (Opiz) Wollenw. and Hochapf.] which is cosmopolitan in its distribution (Morgan-Jones, 1967; Boerema, Dorenbosch and van Kesteren, 1968, 1971, 1977).

Through consultation with Dr. G. H. Boerema we were given to understand that isolates of the same organism had been obtained by Dr. D. R. Sumner from roots of corn grown in Georgia. Subsequently, during a survey of fungi associated with populations of the cyst nematode *Heterodera glycines* Ichinohe in Arkansas, Mississippi and Missouri soybean field soils (Morgan-Jones, Gintis and Rodriguez-Kabana, 1981), the fungus was again encountered [it is referred to in that publication as "black yeast (I)" since, in its cultural characteristics, it somewhat resembles species of the black yeast complex (sensu de Hoog and Hermanides-Nijhof, 1977) and pycnidia were not

PLATE 1. A, 10-day old colony on MEA; B, 10-day old colony on PDA; C, 7-day old colony on cellulose agar; D, clustered pycnidia on cellulose agar; E, SEM view of pycnidial cluster; F, droplet-like deposits on hypha (stained with aniline blue); G, appendage-like pycnidial hyphae; H, uni-ostiolate pycnidia on cellulose agar.


A
B
C
D
250µm
E
50µm
F
10µm
G
H
200µm

initially formed].

This *Phoma*, which is not known to occur in Europe (Boerema, personal communication), where *P. pomorum* is quite common, is described here as a new species.

MATERIALS AND METHODS

All isolates, including three obtained from Dr. D. R. Sumner, were single-spored prior to use for cultural studies under standardized conditions. Colony characteristics and radial growth rates of cultures were determined on potato dextrose agar (Difco) and malt extract agar (Difco) plates incubated at various temperatures (20, 25, and 30 C respectively) in the dark. Four replicates per treatment were used. Cultures were initiated in Petri dishes from agar discs bearing mycelium, 5mm in diameter (obtained with a No. 2 cork borer), derived from actively growing margins of 7-day old colonies growing on PDA. Two cellulose agar [Eggins and Pugh, 1962, but substituting cellulose (Sigmacell®) Type 20 for ball-milled Whatman's cotton cellulose powder] culture plates were prepared for each isolate, incubated at 25 C, and exposed to a cycle of alternating 12 hours near ultra-violet illumination (Westinghouse 20 watt F20T12/BLB) and 12 hours white light (Westinghouse 20 watt F20T12/CW). Determinations of radial growth were made after 4 days. Measurements of pycnidial and conidial size were made from cellulose agar plates after 10 days. For each isolate 10 pycnidia and 20 conidia were measured. Representative cultures (one from each substrate source) have been deposited at the American Type Culture Collection.

Pycnidia were embeded in plastic methacrylate. Sections 3 microns thick were obtained using a Sorvall® JB-4 microtome and stained in Delafield's hematoxylin followed by congo red. Specimens for scanning electron micrography were dried using a Denton Vacuum DCP-1 critical point drying apparatus and coated with gold and palladium using a Denton DV-502 vacuum evaporator. Micrographs were obtained using a Phillips AMR model 1000 scanning electron microscope.

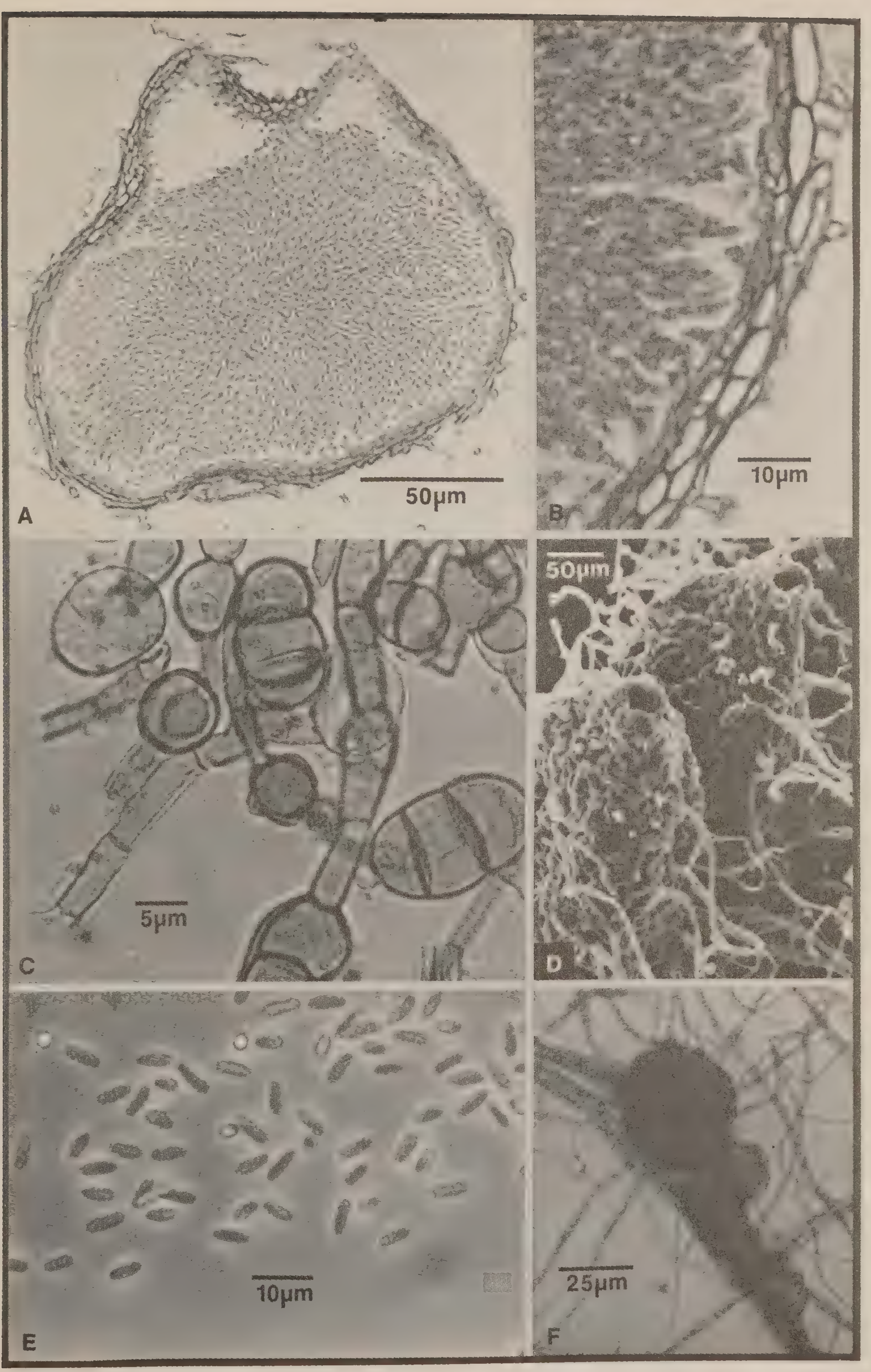
TAXONOMIC PART

Phoma americana sp. nov.

Maculae amphigenae, ellipticae, brunneae, marginibus rubellis, 2 - 4mm longae. Pycnidia partim immersae in maculis.

Coloniae in agaro maltoso olivaceae, mycelio sparso aereo, post 4 dies 25 C and 19mm diametro, reverso olivaceo; in agaro decocto

PLATE 2. Type isolate. A, V.S. bi-ostiolate pycnidium; B, section of pycnidial wall; C, chlamydospores; D, SEM view of uniostiolate pycnidia; E, conidia; F, pycnidial primodium.


50µm
A
10µm
B
5µm
C
50µm
D
10µm
E
25µm
F

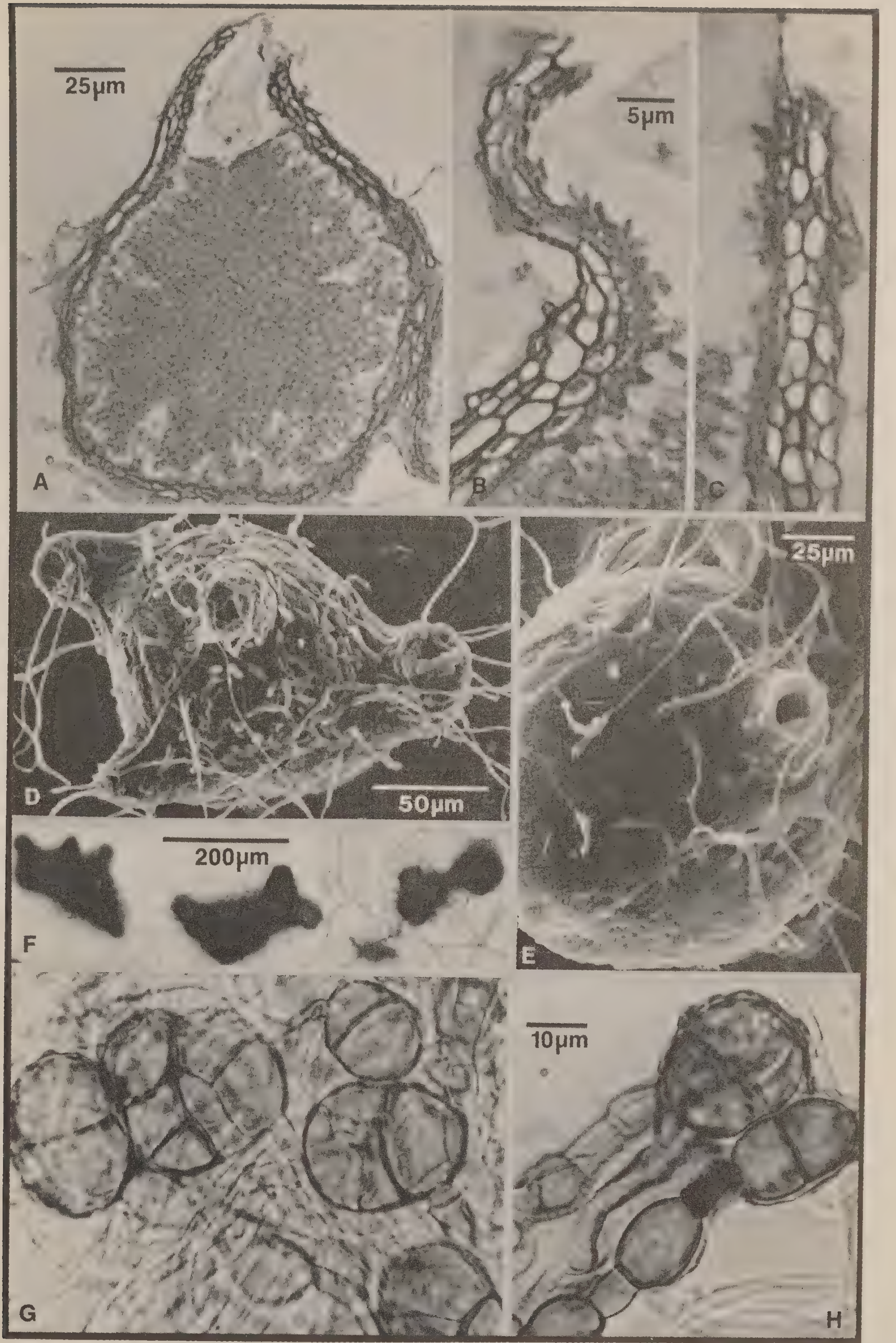
tuberorum olivaceae, lanosae vel floccosae, margine sparsae, post 4 dies 25 C ad 53mm diametro, celeriter crescentes, reverso brunneo. Mycelium ex hyphis septatis, ramosis, subhyalinis vel pallide brunneis, levibus, 1.5 - 3µm crassis compositum; hyphis interdum irregulariter inspissatis, interdum fasciculatis. Pycnidia solitaria vel gregaria vel confluentia, subglobosa vel ampullacea, brunnea vel fusca, partim immersa vel superficialia, pseudoparenchymatica, ostiolata, saepissime collo brevi praedita, 100 - 220µm diam.; paries plerumque cellularum isodiametricarum compositum. Cellulae conidiogenae (phialides) hyalinae, simplices, ex cellulis interioribus parietis pycnidii, ampulliformes, 3 - 5 X 3 - 4µm. Conidia enteroblastica, hyalina, simplicia, plerumque biguttulata, cylindrica vel ellipsoidea, utrinque rotundata, levia, plerumque continua, interdum uniseptata, 5 - 7 X 2 - 2.5µm. Chlamydosporae intercalares vel terminales, solitariae vel catenulatae, subglobosae, globosae, ellipsoideae vel irregulares, uni-, bi- vel multicellulares, crassitunicatae, leves vel asperatae, pallide brunneae vel brunneae, 15 - 40µm diam.

In foliis vivis Tritici, Montgomery County, Alabama, April 1981, A. K. Hagan, AUA, holotypus.

Figures 1 and 2; plates 1,2 and 3.

Lesions amphigenous, elliptical, brown, margin reddish in color. Pycnidia partly immersed in the leaves. Colonies on malt extract agar (Plate 1, A) olivaceous, with sparse aerial mycelium, particularly in a wide marginal zone, attaining a diameter of 9mm at 20C after 4 days, 19mm at 25 C and 20mm at 30 C, center darker and thinly floccose or in part slightly ropy in appearance, reverse olivaceous; on potato dextrose agar (Plate 1, B) pale to dark olivaceous, zonated, lanose or somewhat floccose, margin thin, generally darker towards the center, attaining a diameter of 39mm at 20 C after 4 days, 53mm at 25 C and 57mm at 30 C, reverse brownish. On both MEA and PDA mature pycnidia are produced sparsely after 10 days, partly immersed in the agar. Colonies on cellulose agar (Plate 1, C) with very little aerial mycelium, producing abundant pycnidia superficially after 7 days. Mycelium composed of septate, branched, subhyaline to pale brown, smooth, 1.5 - 3µm wide hyphae; hyphae sometimes irregularly thickened, occasionally bearing more or less hemispherical or flattened, droplet-like deposits (Plate 1, F), sometimes aggregated into closely appressed strands. Pycnidia solitary or gregarious or frequently, especially on cellulose agar, confluent, subglobose to flask-shaped, brown to blackish brown, partly immersed or superficial, pseudoparenchymatous, covered to varying degrees by hyphae (Plates 1, E; 2, D; 3, D, E), frequently bearing long, unbranched, flexuous, appendage-like, 1 - 1.5µm wide hyphae which are sometimes slightly swollen at their tips (Plate 1, G), with one or more ostioles (up to four), usually bearing one or more short necks, 100 - 220µm in

PLATE 3. Corn isolate. A, V. S. pycnidium; B, C, sections of pycnidial wall; D, E, SEM views of multi - and uniostiolate pycnidia; F, pycnidial clusters; G, H, chlamydospores.


25μm
A
5μm
B
C
D
50μm
25μm
200μm
F
E
10μm
G
H

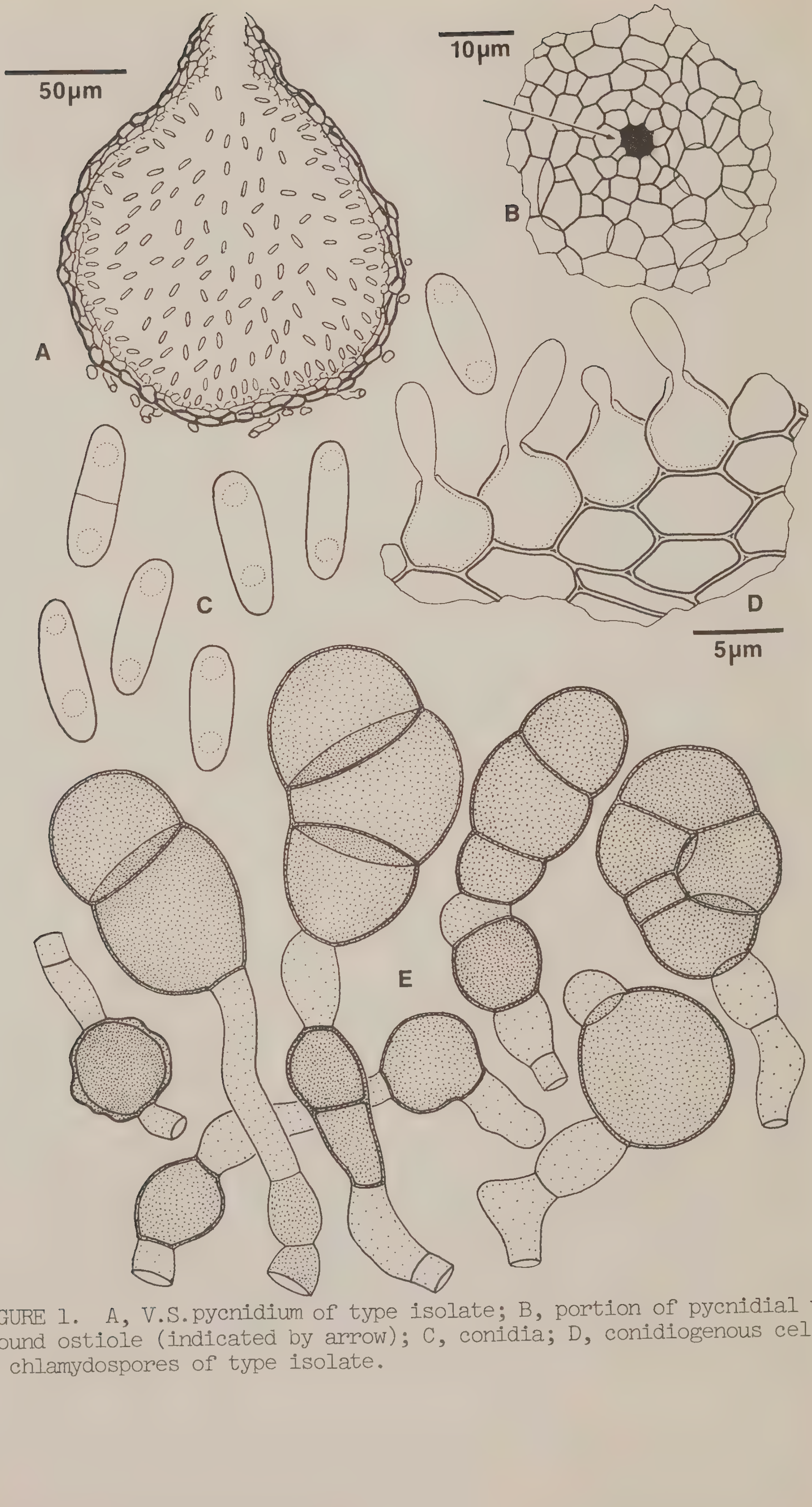


FIGURE 1. A, V.S.pycnidium of type isolate; B, portion of pycnidial wall around ostiole (indicated by arrow); C, conidia; D, conidiogenous cells; E, chlamydospores of type isolate.

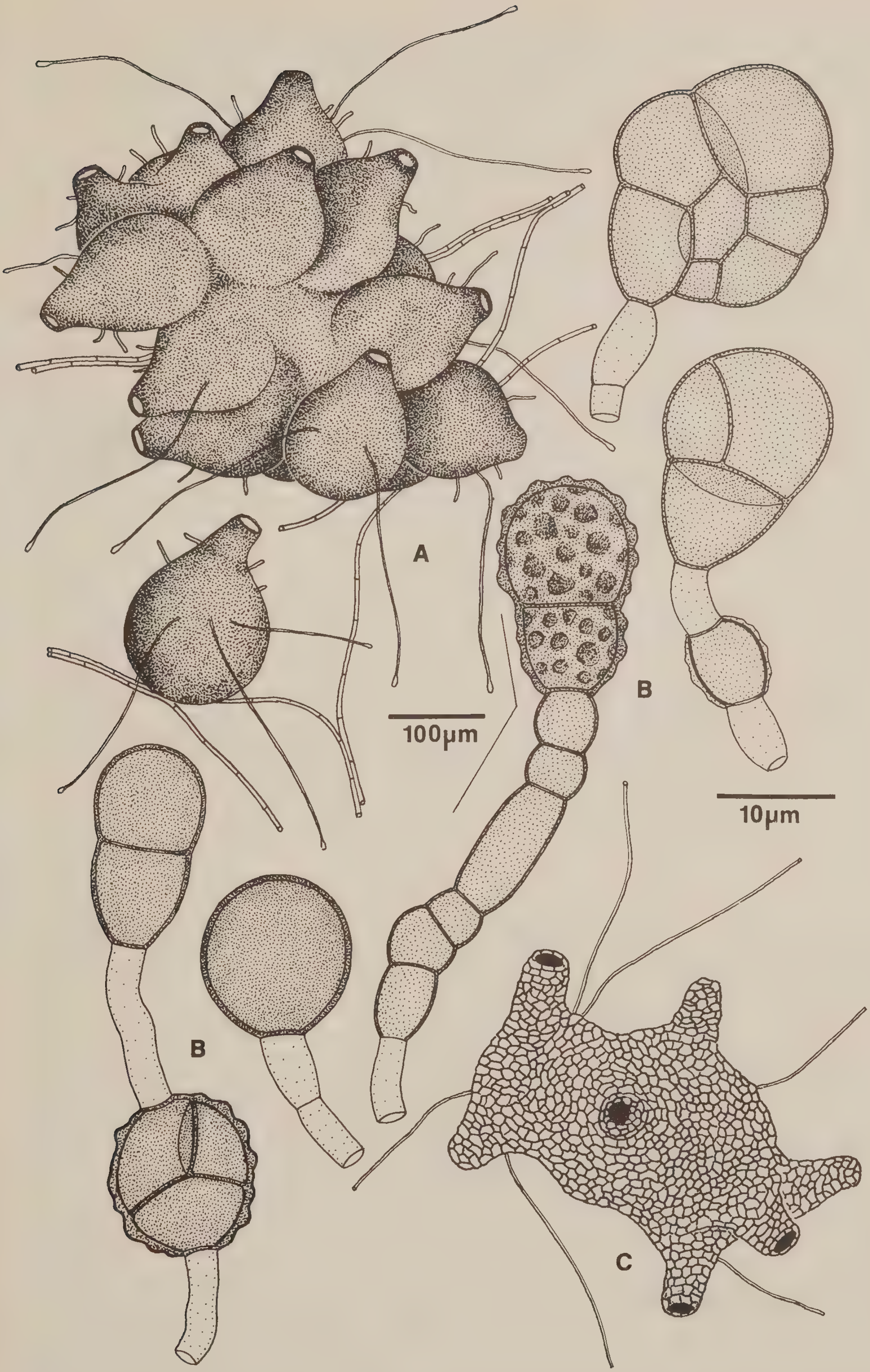


FIGURE 2. A, pycnidial cluster on cellulose agar; B, chlamydospores of corn isolate; C, heavily confluent pycnidial cluster.

diameter where solitary; where confluent the pycnidial mass (Plates 1, D; 3, F; Fig. 2, A) can reach up to 850µm in diameter and contain as many as 10 to 14 separate units as evidenced by the number of necks; wall composed of isodiametric or somewhat elongate cells (Plates 2, B; 3, B, C), up to four layers (7 - 11µm thick), frequently slightly thicker in the zone of transition between the neck and the main pycnidial body with individual cells 3.5 - 5µm in diameter, wall cells becoming progressively elongate towards the pycnidial base where frequently only one layer is present and cells measure 8 - 9 X 1.5 - 2.5µm. Conidiogenous cells phialidic, hyaline, simple, smooth-walled, borne on the innermost cells of the pycnidial wall up to the base of the neck region (Plate 3, B), subglobose to broadly flask-shaped, 3 - 5 X 3 - 4µm. Conidia enteroblastic, hyaline, simple, frequently biguttulate, cylindrical or narrowly ellipsoidal, obtuse at each end, smooth, continuous or occasionally one-septate, 5 - 7 X 2 - 2.5µm. Exuded conidial mass salmony in color. Chlamydospores very variable, intercalary or terminal, solitary or in chains, subglobose, ellipsodial or irregular, uni-, bi - or multicellular, when septate phragmosporous or dictyosporous, thick-walled, smooth or roughened, pale brown to brown, 15 - 40µm in diameter, non-septate chlamydospores 15 - 18µm; chlamydospores produced abundantly on PDA, sparsely on MEA and cellulose agar.

On leaves of wheat, roots of corn and in cysts of *Heterodera glycines*; North America.

Collections examined: on *Triticum aestivum* L., Montgomery County, Alabama, April 1981, A. K. Hagan, AUA, holotype; on *Zea mays* L., Baker County, Georgia, May 5, 1980, Miller County, Georgia, May 22, 1980, Tift County, Georgia, May 28, 1980, D. R. Sumner, AUA; from cysts of *Heterodera glycines* from soybean field soils, Lee County, Arkansas, Pontotoc County, Mississippi, Pemiscot County, Missouri, July 1981, G. Morgan-Jones and B. O. Gintis, AUA.

ADDITIONAL NOTES

Although the seven strains of *Phoma americana* represent a distinct taxon, considerable variation is exhibited among them in some regards particularly in pycnidial and chlamydospore characteristics.

On cellulose agar the strains derived from nematode cysts failed to show pycnidial clustering and confluence to the same degree as in the others but multiostiolate pycnidia were abundant. It should be noted, however, that there is sometimes difficulty in distinguishing between clustered pycnidia derived from the confluence of a few primodia and bone fide single, but multiostiolate, entities. One strain from corn differed by failing to produce any pycnidia on this medium.

The type isolate produced no chlamydospores on cellulose agar, whereas such structures were produced sparsely on this medium by the other strains and moderately in the case of the corn isolate that produced no conidia. The degree of chlamydospore production on

MEA and PDA respectively also varies among strains. Furthermore the type of chlamydospore predominating varies. The corn isolate that failed to produce pycnidia produced single-celled, heavily melanized, roughened chlamydospores almost exclusively.

One-septate conidia were encountered, though infrequently, mainly in the corn isolates.

Phoma americana is easily distinguished from other species, including *P. pomorum*, by its chlamydospores, relatively thick-walled pycnidia, and its slow growth on malt extract agar [*P. pomorum* attains a diameter of 5 - 7.5cm on MEA after 7 days (Dorenbosch, 1970)].

ACKNOWLEDGMENTS

We have had the benefit of consultation with Dr. Gerhard H. Boerema, Wageningen, The Netherlands, and are grateful to him for his comments on some of our isolates. Dr. D. R. Sumner, Tifton, Georgia, kindly provided us with cultures of his isolates from corn. Dr. Richard T. Hanlin, University of Georgia, kindly reviewed the manuscript.

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A NEW SPECIES OF *AMANITA*

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ABSTRACT

Amanita media (fig. 1) is described as new from Alabama. It appears to be intermediate between sections *Lepidella* and *Validae*.

Amanita media Jenkins, sp. nov.
Holotype: Alabama - rest area, Hiway 231, between Florala and Opp, Al, 11. vi. 1981, Jeannie and David Jenkins 1629(DTJ).

Corpus fructus medius. Pileus: quanto 78 mm latus, planus convexusque cum in orbe loco depresso tenuique, margo non striatus, pileipellis mediocriter ac facile separabilis, fulgens, levis, argenter ac alba, verum cum colore destincto vero, praecipue in orbe, caro albue, quanto 7 mm crassus ad centrum, fastigata adversus marginem. Lamellae: densae, annexae, gilvae; lamellulae truncae convertentes in superficie, tenuissime attenuata. Stipes: quanto 50 x 14-15 mm, solidus, gilvus, levis, tegumen partim et in forma apicis, albus, delicatissimus, iam evanescens bulbus ad basem obovatus, quanto 30 x 25 mm; reliquae universi teguminis ita panni fortuiti floccosique in bulbo supero, albae, facile remotae. Odoratio no distinctus. Spores 4.69-5.47 x (9.37) 10.15-12.50 µm.

Fruit body medium, solitary. PILEUS: up to 78 mm diam, plano-convex with slight depression in center, margin non-striate, pileipellis fairly easily separable, shiny, smooth, silvery white, but with distinct tannish tint primarily on disc, flesh white, up to 7 mm thick at center, tapering toward margin; universal veil as few small, floccose patches. LAMELLAE: crowded, adnexed, creamy-white; lamellulae truncate to slightly attenuate. STIPE: up to 50 x 14-15 mm, solid, creamy-white, smooth; partial veil apical, white, very delicate, soon disappearing; basal bulb obovate, up to 30 x 25 mm; universal veil remnants as random, floccose patches on upper bulb, white, easily removed. Smell not distinct.

PILEIPELLIS: filamentous hyphae densely interwoven, considerable gelatinization, 2-6 µm diam, moderately abundant, oleiferous hyphae present. PILEUS TRAMA: filamentous hyphae undifferentiated, moderately branched, no clamps, 2-7 µm diam; inflated cells abundant, mostly terminal, mostly elongate, up to 191 x 38 µm. LAMELLA TRAMA: bilateral; filamentous hyphae undifferentiated, no clamps, 2-8 µm diam; inflated cells elongate, terminal. SUBHYMENIUM: inflated ramose to subcellular, no clamps. BASIDIA: up to 43 x 4-11 µm, mostly 4-sterigmate, but with a consipcuous number of 2-sterigmate, thin walled, no clamps. UNIVERSAL VEIL: filamentous hyphae at base of stipe abundant, sparsely to moderately branched, no clamps, 3-7 µm diam, some gelatinization, irregularly

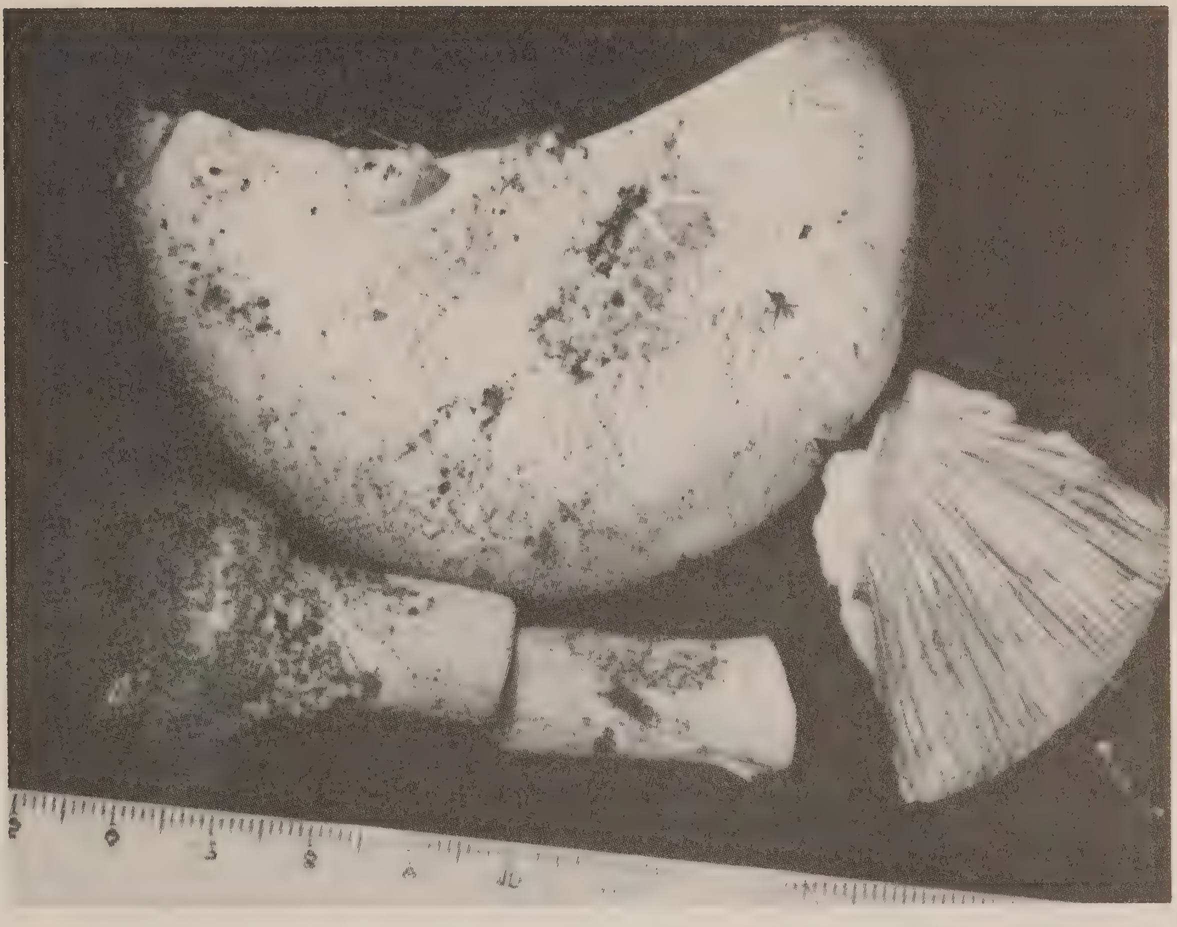

Fig. 1. *Amanita media* Jenkins (DTJ 1629)

disposed; inflated cells abundant, globose, subglobose, broadly elliptic, up to 78 x 78 μm, very few small elliptical cells, mostly short, terminal chains: tissue on pileus the same. STIPE TRAMA: filamentous hyphae undifferentiated, sparsely branched, no clamps, 3-6 μm diam; inflated cells terminal, clavate, longitudinally oriented, up to 154 x 41 μm, most smaller. PARTIAL VEIL: almost exclusively filamentous hyphae, moderately branched, no clamps, 2-8 μm diam, interwoven; inflated cells sparse, small, terminal.

SPORES: 4.69-5.47 x (9.37)10.15-12.50 μm, ($\underline{E}$ = 1.99-2.29; $\underline{E}^{m}$ = 2.12), elongate to cylindric, adaxially flattened, thin walled, hyaline, amyloid, spore print white; contents guttulate; apiculus sublateral, cylindrical.

Habitat and distribution: terrestrial, loblolly pine and mixed hardwoods, Alabama.

Collections examined: rest area, U.S. Hiway 231, between Florala and Opp, Alabama, 11. vi. 1981, Jeannie and David Jenkins 1629(DTJ): roadside, U.S. Hiway 231, near Florala, Alabama, 11. vi. 1981, Jeannie and David Jenkins 1657(DTJ).

Discussion: *Amanita media* appears to be intermediate between sections *Lepidella* and *Validae*. The characters of elongate to cylindrical spores, whitish pileus, and a delicate partial veil appear to indicate a relationship with section *Lepidella*. However, features such as the easy removal of volval patches from pileus, non-appendiculate pileus margin, and the pileus margin not exceeding the gills indicates a relationship with section *Validae*.

Although the above characters are used to delineate sections *Lepidella* and *Validae* respectively, exceptions to the definitiveness of each character can occur. For example, the whitish pileus is most characteristic of members of section *Lepidella*. However, *Amanita demissa* Corner & Bas, section *Validae*, has a whitish pileus with a grayish disc. Singer (1975) mentions that there are a few members of section *Validae* with cylindrical spores, a feature more commonly associated with section *Lepidella*.

The features which characterize section *Validae*, i.e., easy removal of volval material from the pileus and the non-appendiculate pileus margin, can occasionally be found in members of section *Lepidella*. For example, the volval remnants of *Amanita polypyramis* can easily be washed off by rain or removed by scraping. The appendiculate margin is quite definitive when present. The character is the result of the adherence of the partial veil fragments to the pileus margin as the fruit body expands. Frequently, however, this material can easily be washed off or fall off with age, resulting in a non-appendiculate margin.

It is obvious from the above examples that the variability of characters within individual specimens is frequent enough that no single feature can unquestionably indicate a sectional relationship. As can be seen from the description of *Amanita media*, it possesses combinations of characters which indicate a possible relationship with two different sections. Therefore, *Amanita media* will not be assigned to a particular section at this time. Future collections may allow for better discernment.

ACKNOWLEDGEMENTS

My thanks are extended to Dr. James W. Kimbrough, University of Florida, for reviewing this article.

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DESCRIPTIONS OF NEW SPECIES AND COMBINATIONS IN MICROSPHAERA AND ERYSIPHE (III)

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The present paper continues the taxonomic studies in the genera *Microsphaera* and *Erysiphe*. It comprises some descriptions of new species and a new combination.

1. *Microsphaera neglecta* U. Braun spec. nov.

Syn.: *M. alni* emend. Salmon p.p.; *M. penicillata* f. *ulmi* Jacz. (1927, p.364), nom. nud.; *M. ulmi* (Jacz.) Bunkina, in Vodorosli, griby i mhi Dal´nego Vostoka, p. 42, Vladivostok 1978 (not validly published, combination not indicated, basionym not cited, basionym = nom. nud.).

Mycelium amphigenum, evanescens vel subpersistens. Cleistothecia 65-100 µm diam., cellulae peridii ca. 10-15 µm diam., appendices 5-12, diametro cleistothecii 1-1.5plo longiores, hyalinae, superne tenui- et inferne crassitunicatae, basi 5-8 µm latae, ad apicem dichotome ramosae (4-5x), apice recurvatae, asci 3-6, 40-50 x 30-40 µm, ascosporae 6-7, 15-19 x 10-12 µm.

Holotypus: hospes - *Ulmus americana*, U.S.A., Galeria and Council Hill, Ill., 19-9-1882, Seymour (BPI).[1]

Mycelium effused, amphigenous, usually epiphyllous, evanescent to subpersistent. Cleistothecia 65-100 µm in diam., cells obscure, polygonal to rounded, ca. 10-15 µm diam., 5-12 ± equatorially inserted appendages, curved and flexuous, 1-1.5 times as long as the cleistothecial diameter, stalk hyaline, coloured at the very base, 0-1-septate, moderately thick-walled throughout or thin above and thick below, 5-8 µm wide near the base, apex 4-5 x regularly branched, the branchings form a small, compact complex, tips recurved, primary branches sometimes somewhat elongated and slightly recured, 3-6 asci, mostly without stalk, 40-50 x 30-40 µm, 6-7 spores, 15-19 x 10-12 µm (fig. 1).

I studied an additional sample of the species (on

Ulmus fulva, U.S.A., Columbia, Mo., 9-10-1910, leg. ?, BPI). The new species resembles *M. juglandis-nigrae* U. Braun (distinguished by 4-5-spored asci). The name *M. penicillata* f. *ulmi* Jacz. has been introduced for the fungus on *Ulmus americana* in N. America. Therefore, this name is a synonym of *M. neglecta*. The identity of Bunkina′s collection from the Far East of the Soviet Union is uncertain.

2. *Microsphaera magnifica* U. Braun spec. nov.

Syn.: *M. alni* emend. Salmon p.p.

Mycelium amphigenum, subpersistens. Cleistothecia (75-) 85-125 µm diam., cellulae peridii 10-25 µm diam., appendices 5-18, diametro cleistothecii 1-1.5plo longiores, hyalinae, superne tenui- et inferne crassitunicatae, basi 6-10 µm latae, 0-1-septatae, ad apicem dichotome ramosae (4-6x), apice recurvatae, asci 4-6, 45-65 x 40-55 µm, ascosporae 3-5, (16-) 20-26 x 10-15 µm.

Holotypus: hospes - *Magnolia acuminata*, U.S.A., Bureau of Plant Industry, Harrisburg, Pa., Northeast Erie Co., 18-10-1920, Cubbin (BPI).

Amphigenous, mycelium effused or in spots, subpersistent. Cleistothecia scattered, (75-) 85-125 µm in diam., cells conspicuous, 10-25 µm diam., 5-18 equatorially inserted appendages, stiff to flexuous, 1-1.5 times as long as the cleistothecial diameter, stalk hyaline, coloured near the base, smooth, aseptate or with a single septum at the base, thin-walled above, thick towards the base, 6-10 µm wide below, sometimes enlarged at the very base (-15 µm), apex 4-6 x branched, ornate, somewhat loose, ultimate tips distinctly recurved, often somewhat circinate to subhelicoid, 4-6 asci, mostly without stalk, 45-65 x 40-55 µm, 3-5 spores, (16-) 20-26 x 10-15 µm (fig. 2).

The new species is near to *M. nemopanthis* Peck, *M. ornata* U. Braun and related taxa. It is distinguished by the features of the asci and ascospores. I investigated two additional samples (on *Magnolia acuminata*, U.S.A., Washington, Agric. Grounds, 22-11-1910, Norton, BPI; on *Magnolia liliflora*, U.S.A., Semmes, Alab., 4-11-1946, Gill, BPI).

3. *Microsphaera neomexicana* U. Braun spec. nov.

Mycelium amphigenum, subpersistens. Cleistothecia 90-140 µm diam., cellulae peridii 10-20 µm diam., appendices 10-30, diametro cleistothecii 0.75-1.5 (-2)plo longiores, hyalinae, tenuitunicatae, eseptatae, basi 5-10 µm latae, ad apicem irregulariter dichotome ramosae (3-6 x), apice non recurvatae, asci 6-16, 45-65 x 25-40 µm, ascosporae 3-6, 18-24 x 10-14 µm.

Holotypus: hospes - *Forestiera neomexicana*, U.S.A., Flaggstaff, Ariz., 24-9-1919, Godding (BPI).

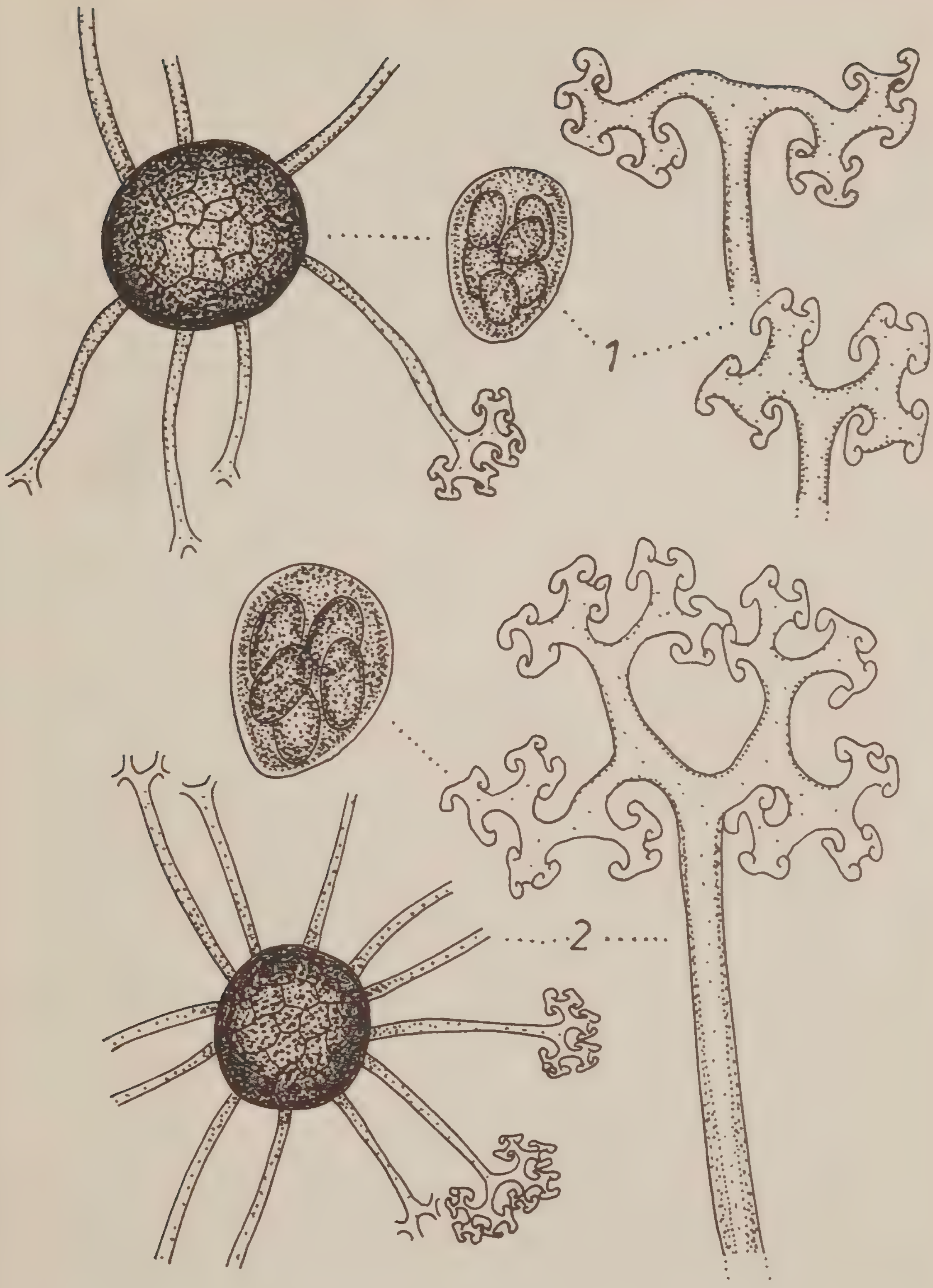

Fig. 1-2. Microsphaera neglecta (1), ascocarp, ascus, two branched parts of the appendages. Microsphaera magnifica (2), ascocarp, ascus, appendage. U. Braun del.

Amphigenous, mycelium effused, subpersistent. Cleistothecia 90-140 µm in diam., cells of the wall polygonal, ca. 10-20 µm diam., appendages numerous, about 10-30 per ascocarp, equatorially inserted or somewhat in the upper half, radially spread, rather stiff, 0.75-1.25 (-2) x as long as the cleistothecial diameter, stalk hyaline, aseptate, rough, thin-walled, slightly thicker towards the base, about 5-10 µm wide below, apex 3-6 times branched, branchings very irregular, loose, diffuse, deeply cleft, tips mostly straight, obtuse, few recurved, asci 6-16, stalked, 45-65 x 25-40 µm, 3-6-spored, 18-24 x 10-14 µm (fig. 3).

The species resembles *M. diffusa* C. & P. It differs by relatively short appendages and very numerous asci. *M. neomexicana* is also close to *M. prasadii* Bhatnagar & Kothari, a species on *Hamiltonia* in India (distinct by very numerous appendages).

4. *Microsphaera friesii* Lév. var. *dahurica* U. Braun var. nov.

Syn.: *M. alni* p.p., ss. Homma (1937); *M. friesii* ss. Bunkina (1979).

Cleistothecia 80-105 µm diam., asci 4-5, ascosporae 6-7, 16-24 x 9-12 µm.

Holotypus: hospes - *Rhamnus dahurica*, Japan, Morioka, Prov. Rikuchu, 23-9-1903, Yamada (TNS-F-217398).[1]

Amphigenous, mostly epiphyllous, subpersistent. Cleistothecia 80-105 µm in diam., cells obscure, polygonal to rounded, ca. 8-25 µm diam., appendages ± equatorially inserted, 7-15, about as long as the cleistothecial diam. (0.75-1.25x), stalk hyaline, sometimes coloured near the base, smooth, thick-walled towards the base, thin above, 7-11 µm wide below, apex 4-6 x closely branched, regular, tips recurved when mature, 4-5 asci, 40-50 x 25-45 µm, 6-7-spored, 16-24 x 9-12 µm (fig. 4).

The number of ascospores distinguishes var. *dahurica* from var. *friesii* (3-5). The spores of var. *friesii* are smaller.

5. *Microsphaera miurae* U. Braun spec. nov.

Syn.: *M. alni* p.p., ss. Homma (1937).

Mycelium amphigenum, subpersistens. Cleistothecia 70-115 µm diam., cellulae peridii 10-20 µm diam., appendices 5-10, diametro cleistothecii 1-2plo longiores, hyalinae, 0-1-septatae, tenuitunicatae, basi 6-10 µm latae, ad apicem dichotome ramosae (3-5x), apice recurvatae, asci 3-5, 40-65 x 30-45 µm, ascosporae 4-5, 18-25 x 12-15 µm.

Holotypus: hospes - *Lonicera morowii*, Japan, Omagari, Prov. Uzen, 3-11-1908, Miura (TNS-F-214110).

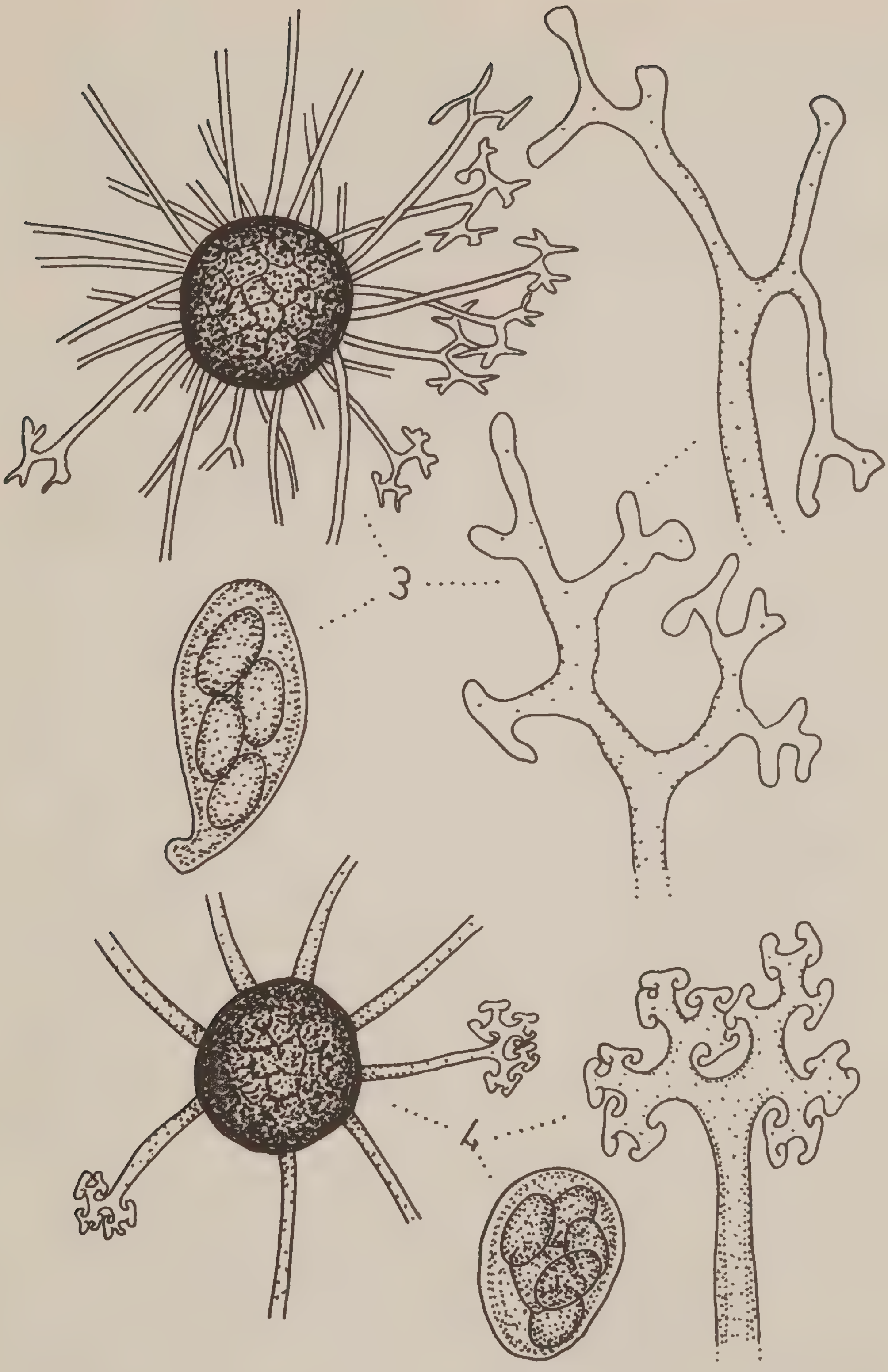

Fig. 3-4. *Microsphaera neomexicana* (3), ascocarp, ascus, two branched parts of the appendages. *Microsphaera friesii* var. *dahurica* (4), ascocarp, ascus, appendage. U. Braun del.

Mycelium amphigenous, subpersistent. Cleistothecia 70-115 µm in diam., cells obscure, ca. 10-20 µm diam., 5-10 equatorial appendages, rather stiff, often deeply cleft, stalk hyaline, sometimes yellowish, brown near the base, 0-1-septate, thin-walled, slightly thicker below, 1-2 x diam. of the cleistothecium in length, 6-10 µm wide below, apex 3-5 x loosely branched, primary branches usually elongated, often somewhat twisted in different planes, asci 3-5, without stalk, 40-65 x 30-45 µm, 4-5 spores, 18-25 x 12-15 µm (fig.5).

I examined some additional samples on *Lonicera* from Japan (ex TNS): *Lonicera morowii*, *L. orientalis*, *L. chamissoi*, and *L. ciliata*. All collections agree with *M. miurae*. The species is morphologically related to *M. miyabeana* U. Braun on *Styrax* in Japan and allied taxa. It is not related to *M. lonicerae* (cleistothecial appendages with straight ultimate tips) and *M. caprifoliacearum* U. Braun (an American species, apex of the appendages richly branched, compact).

6. *Microsphaera ornata* U. Braun var. *europaea* U. Braun var. nov.

Syn.: (Pseudonym), *M. betulae* (DC.) Magn., Ber. deutsch. bot. Ges. 16, p.67 (1898).

Cleistothecia 75-105 µm diam., appendices 4-13, diametro cleistothecii 0.5-1 (-1.5)plo longiores.

Holotypus: hospes - *Betula pubescens*, Bavaria, Bayreuth, Oct. 1874, de Thümen, Myc. univ. 56 (K).[1]

Because of the changed "Art. 13" of the ICBN, adopted at the Sydney Botanical Congress (1981), the name *Microsphaera betulae* (DC.) Magn., published as a combination with the basionym *Erysiphe betulae* DC. (1815, = *Phyllactinia guttata*), becomes a synonym of the latter species. Hence it is necessary to introduce a new name for the European *Betula-Microsphaera*. After seeing a large amount of material on different American *Betula* species, I prefer to consider the European fungus as a mere variety of *M. ornata*. The collections on *Betula lenta* and *lutea* are well distinguished from European specimens. Samples on *Betula sandbergii* and *pumila* (studied mat. ex herb. AZ), however, are intermediate. The cleistothecial appendages on *B. sandbergii* are only 0.5-1 times as long as the cleistothecial diam. (1-1.5 x on *B. lenta* and *lutea*). The only constant difference between European and American collections is in the number of appendages. American specimens possess always numerous appendages (average > 10)."*M. betulae*" on *B. dahurica* in Asia (Bunkina 1979) belongs undoubtedly to *M. ornata* var. *ornata*.

7. *Erysiphe cichoracearum* DC. var. *poonaensis* (Chiddarwar) U. Braun stat. nov.

Bas.: *Erysiphe poonaensis* Chiddarwar, Current Sci.

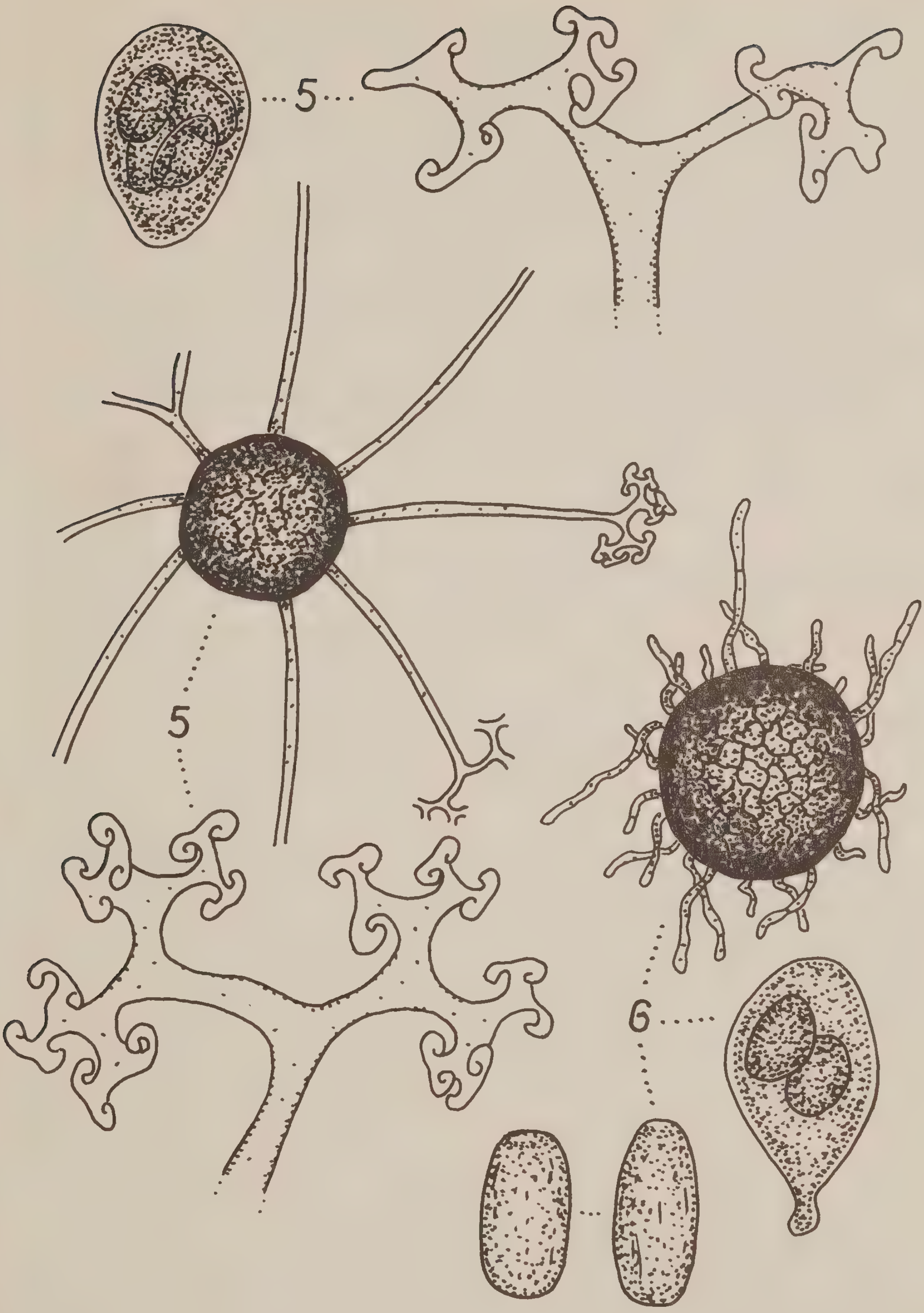

Fig. 5-6. *Microsphaera miurae* (5), ascocarp, ascus, two branched parts of the appendages. *Erysiphe cichoracearum* var. *poonaensis*, ascocarp, ascus, two conidia. U. Braun del.

24(12), p.421 (1955).

Studied mat.: on Goniocaulon glabrum, Poona, India, IX. 54, P. P. Chiddarwar (IMI 61831, type).[1]

Amphigenous, mycelium persistent, conidia in chains, ellipsoid to barrel-shaped, 24-29 x 12.5-15 µm (dried!). Cleistothecia 90-145 µm in diam., cells obscure, appendages numerous, basally attached, mycelioid, strongly interlaced with the mycelium, brown when mature, thin-walled, septate, simple, ca. 5-10 um wide, shorter than the cleistothecial diam., numerous asci per fruit body (ca. 8-12), stalked, 50-70 x 25-35 µm, 2-spored, spores subglobose, ca. 14-19 x 10-13 µm (fig. 6).

Var. poonaensis differs from var. cichoracearum by small conidia and small, subglobose ascospores. The differences are only slight; the fungus is hardly more than a variety of E. cichoracearum.

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[1] I am deeply indebted to the staffs of the mentioned herbaria (BPI, TNS, K, IMI) that have sent valuable material for the present investigations.

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TAXONOMIC NOTES ON SOME POWDERY MILDEWS (II)

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The present paper contains the description of *Uncinula oleosa* Zheng & Chen var. *zhengii* var. nov. and the new combination *Uncinula necator* (Schw.) Burr. var. *ampelopsidis* (Peck) stat. nov. Furthermore, a discussion about the impact of the changed "Art. 13" (ICBN) on the Erysiphaceae is included.

1. *Uncinula* in Asia on *Tilia*

Zheng & Chen (1977) described *Uncinula oleosa* on *Tilia tuan* from China. The species is clearly different from *U. clintonii* Peck, an American fungus on *Tilia americana*, by the features of the appendages. *U. oleosa* has few appendages (about 8-23 per ascocarp), whereas *U. clintonii* possesses a higher number (average > 20). The appendages of *U. clintonii* are enlarged from base to top, including the coiled part. The apical part of the appendages in *U. oleosa* is not enlarged, its width is sometimes even decreasing. Homma (1937) and subsequent authors determined Japanese collections on *Tilia* either as *U. clintonii* or *U. miyabei*. I reinvestigated some specimens on *Tilia japonica* (TNS-F-216134, 216135, 216137). The material agrees entirely with *U. oleosa* and is characterized as follows:

Uncinula oleosa Zheng & Chen, Acta Microbiol. Sinica 17 (4), p.290 (1977)

Mycelium amphigenous, evanescent to subpersistent. Cleistothecia 85-125 µm in diam., cells polygonal to rounded, ca. 10-20 µm diam., 8-25 equatorially inserted appendages, flexuous, sometimes abruptly bent, 1-2.5 x as long as the cleistothecial diam., mostly 1.5-2 x, hyaline, coloured at the base, usually 1-septate, thin-walled, somewhat thicker towards the base, 5-8 µm wide below, width uniform throughout or slightly enlarged upwards (-10 µm), coiled part not enlarged, sometimes even decreasing, apex closely circinate to subhelicoid, oil drops present, especially in the upper half of the appendages,

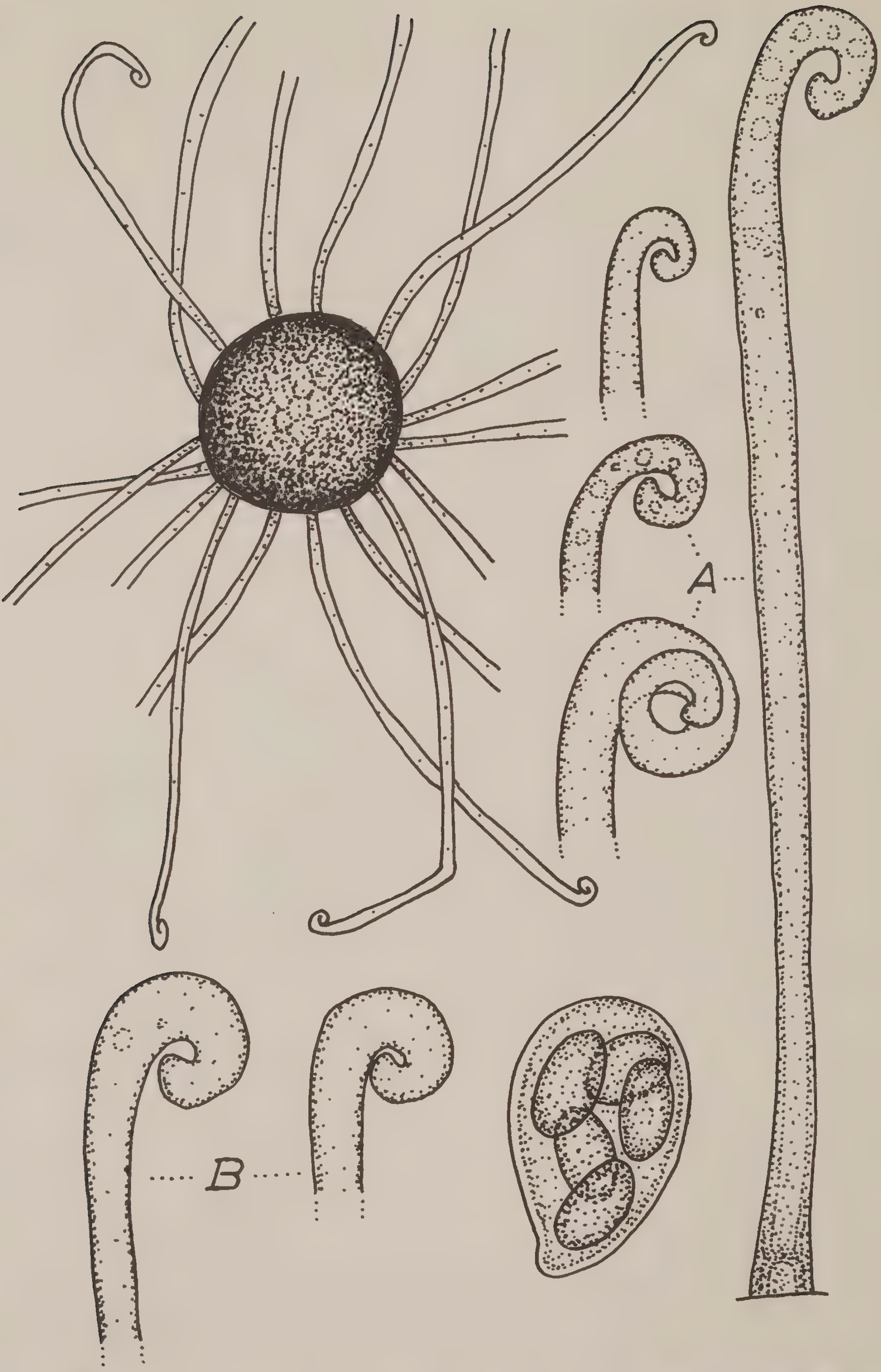

Fig. 1. Uncinula oleosa Zheng & Chen var. oleosa on Tilia japonica, ascocarp, ascus, appendages (A); var. zhengii on Tilia maximowicziana, two upper parts of the appendages (B). U. Braun del.

3-7 asci, without or shortly stalked, 45-60 x 35-50 µm, 5-7 spores, (15-) 18-25 x 10-15 µm (fig. 1).

I studied some collections on *Tilia maximowicziana*. The appendages are 5-7.5 µm wide near the base and increasing upwards (- 7-10, rarely - 14 µm). They are rather regularly increasing from base to top (circinate part). The apex is frequently slightly enlarged, oil drops are rare. Otherwise this form of the fungus coincides with typical *U. oleosa*. It should be regarded as a variety of the latter species. *U. clintonii* and *U. oleosa* are undoubtedly related, but they are morphologically and geographically differentiated.

Uncinula oleosa Zheng & Chen var. *zhengii* U. Braun var. nov. (Etym.: Prof. Zheng, Beijing, Chinese mycologist)

A typo differt appendices ad apicem incrassatae et clavulatae in forma.

Holotypus: hospes - *Tilia maximowicziana*, Japan, Muruyama near Sapporo, 14-10-1925, Homma (TNS-F-216179).

2. *Uncinula necator* (Schw.) Burr. var. *ampelopsidis* (Peck) U. Braun stat. nov.

Bas.: *Uncinula ampelopsidis* Peck, Trans. Albany Inst. 7, p.215 (1872).

Syn.: *Uncinula subfusca* Berk. & Curt., Grevillea 4, p.160 (1876).

U. ampelopsidis is usually included in *U. necator*. The differences between *U. necator* on *Vitis* and the fungus on *Parthenocissus* have been pointed out by Salmon (1900) and Blumer (1933). The appendages of *U. necator* s. str. are long and flexuous (about 1-6 x as long as the cleistothecial diam.). *U. ampelopsidis*, confined to N. America, possesses shorter, rather stiff appendages (length ca. 1-2.5 x diam. cleist.). The average diameter of the ascocarps is larger. The conidial states are agreeing. There is a close overlapping of the cleistothecial features in both species, but the differences are constant. Therefore, I consider *U. ampelopsidis* as a variety. In Europe (Braun 1982) and Japan (Nomura 1981) *U. necator* infects occasionally *Ampelopsis* or *Parthenocissus*. Fruit bodies are not formed and the conidial states correspond with *U. necator* on *Vitis*.

3. Nomenclatural notes

The impact of the changed "Art. 13" (ICBN), adopted at the Sydney Botanical Congress (1981), on the Erysiphaceae is only moderate. Two new combinations have been inevitable. They are already published:

Erysiphe cynoglossi (Wallr.) U. Braun replaces *E. asperifoliorum* Grev.

Sphaerotheca aphanis (Wallr.) U. Braun replaces *Sph. al-*

chemillae (Grev.) Junell

Besides, the citations of some additional species are influenced. The protected status of names adopted by Fries is indicated with the sign " : ". It has to be placed between the original author and Fries. The following list comprises the correct citations of the species in question.

Erysiphe aquilegiae DC.
E. *cichoracearum* DC.
E. *convolvuli* DC.
E. *depressa* (Wallr.) Schlecht.
E. *galeopsidis* DC.
E. *graminis* DC. (= *Blumeria graminis* (DC.) Speer)
E. *heraclei* DC.
E. *hyperici* (Wallr.) Blumer (= *Microsphaera hypericacearum* U. Braun)
E. *pisi* DC.
E. *polygoni* DC.
E. *urticae* (Wallr.) Blumer
Microsphaera astragali (DC.) Trev.
M. *berberidis* (DC.) Lév.
M. *divaricata* (Wallr.) Lév.
M. *euonymi* (DC.) Sacc.
M. *grossulariae* (Wallr.) Lév.
M. *lonicerae* (DC.) Wint.
M. *penicillata* (Wallr. : Fr.) Lév.
Phyllactinia guttata (Wallr. : Fr.) Lév.
Podosphaera clandestina (Wallr. : Fr.) Lév.
Sphaerotheca epilobii (Wallr.) Sacc.
Sph. ferruginea (Schlecht. : Fr.) Junell
Sph. fuliginea (Schlecht. : Fr.) Poll.
Sph. macularis (Wallr. : Fr.) Lind
Sph. pannosa (Wallr. : Fr.) Lév.
Uncinula adunca (Wallr. : Fr.) Lév.
U. *bicornis* (Wallr. : Fr.) Lév. (= *Sawadaea bicornis* (Wallr. : Fr.) Homma)
U. prunastri (DC.) Sacc.

I wish to express my gratitude to the staff of the herbarium TNS for the valuable material that has been used for the present study.

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GIGASPORA RETICULATA: A NEWLY DESCRIBED ENDOMYCORRHIZAL FUNGUS FROM NEW ENGLAND*

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Collections of endogonaceous spores from sand dunes in Rhode Island and an orchard in Massachusetts yielded a previously unknown species of *Gigaspora* with unusually ornate spores. The species, here named *Gigaspora reticulata* sp. nov. forms arbuscular endomycorrhizae.

GIGASPORA RETICULATA Koske, Miller et Walker sp. nov.
(Figs. 1-10)

Sporae cinnamomeae vel obscure castaneae, globosae vel subglobosae, 188 - 340 x 208 - 470 um, in solo singillatim genitae, lateraliter ad cellulam instar suspensoris efformatae. Sporarum tunica turmis duobus separatis strata reticulo alveolato inductis. Turma externa stratis tribus. Stratum exterius 0.5-1 um crassum, cinnamomeum vel castaneum, reticulo 0.5-1 um alto, pagina sporae inter cristas reticuli spinis gradatim decrescentibus vel cristis angustis 0.5-2 um altis. Stratum medium 5-11 um crassum,

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* Journal Paper No. J-10794 of the Iowa Agriculture and Home Economics Experiment Station, Ames, Iowa. Project No. 2266.

hyalinum vel luteolum, strato interiore 0.3-0.7 um crasso adhaerens. Turma interna stratis tribus. Stratum exterius et interius utrumque 1 um crassum, stratum medium 2 um crassum, amorphum. Cellula instar suspensoris 45-87 x 85-140 um, cinnamomea vel castanea. Vesiculae in solo 25-30 x 30-40 um, in fasciculis 10-40 numero, atrobrunneae vel castaneae, projecturis obtusis nodosis. Endomycorrhizae arbusculis formans.

Spores (azygospores?) orange-brown to dark red-brown, globose to subglobose, 208-470 x 188-340 um, borne singly in the soil, laterally on bulbous suspensor-like cells formed at the tips of thick-walled, sparsely septate or coenocytic pale-brown hyphae. Wall structure complex, consisting of two separate groups of wall layers overlain by an alveolate reticulum. Outer wall group three-layered. Outer layer 0.5-1 um thick, orange-brown to red-brown, supporting raised, straight to sinuous interconnecting ridges that form a reticulum 0.5-1 um high, with 4- to 8-sided meshes 2-24 x 2-30 um across. Spore surface between ridges covered with polyhedral, conical or subcylindrical spines, or narrow straight, curved, or angular ridges 0.5-2 um high and 0.25-0.5(-1) um apart; the spines 0.3-1.5 um diam at base, tapering to a point or a rounded tip less

FIGURES 1-9. *Gigaspora reticulata* spores by brightfield (B), differential interference contrast (DIC), or scanning electron (SEM) microscopy.

1. An intact spore showing the reticulate outer covering and the laterally attached bulbous suspensor-like cell (B).

2. The vesicles formed in the soil by *G. reticulata*.

3. A crushed spore that has lost or failed to develop fully the reticulate outer covering, the vestiges of which (ret) can be seen near the spore base. The flexible inner wall-group (iw) and the germination shield (gs) can clearly be seen (DIC).

4. A crushed spore showing the reticulate covering and the flexible inner wall group (iw) (B).

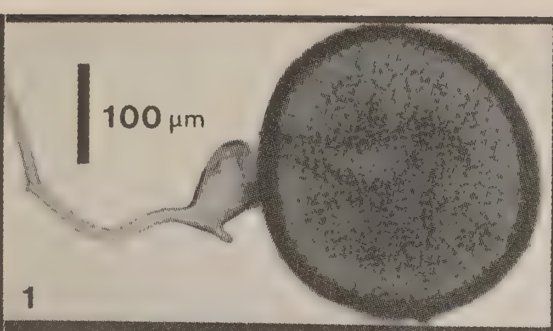
5. Detail of the outer wall-group. The alveolate reticulum, spiny layer, and thick, colored middle layer are evident. The thin, hyaline basal layer is not evident (SEM).

6. Base of a spore showing the bulbous suspensor-like cell with a peg-like hyphal protrusion (SEM).

7. Spore surface detail by brightfield microscopy.

8. Same part of spore surface as in Figure 7, but by differential interference microscopy.

9. Detail of reticulum showing alveoli filled with spines.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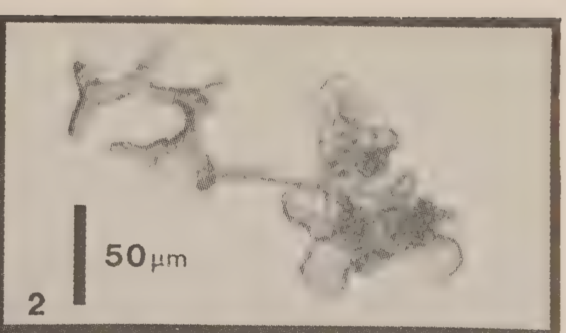
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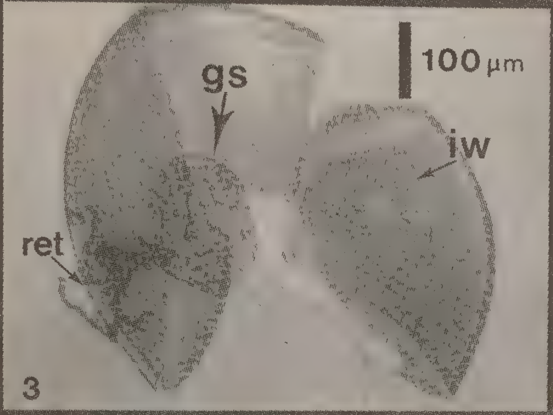
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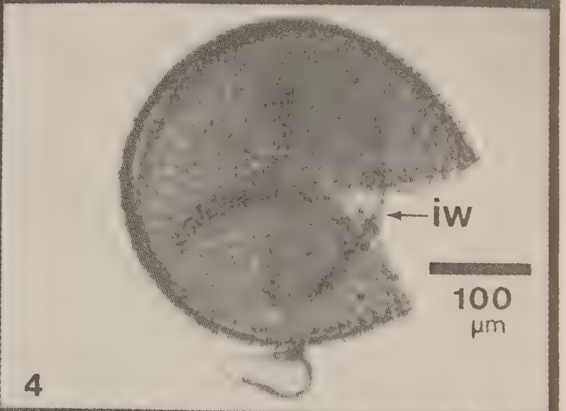
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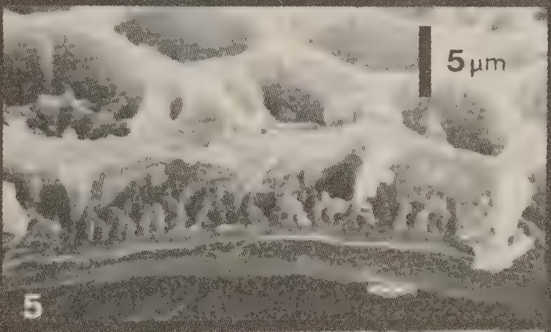
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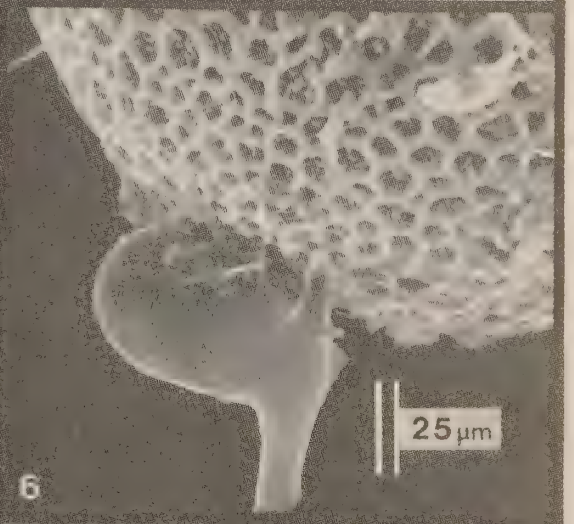
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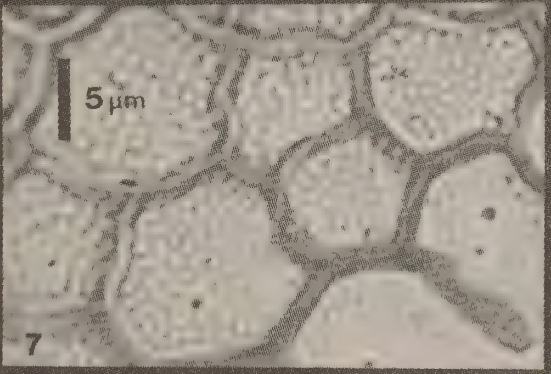
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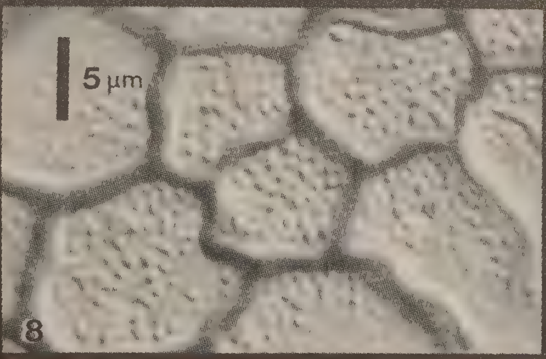
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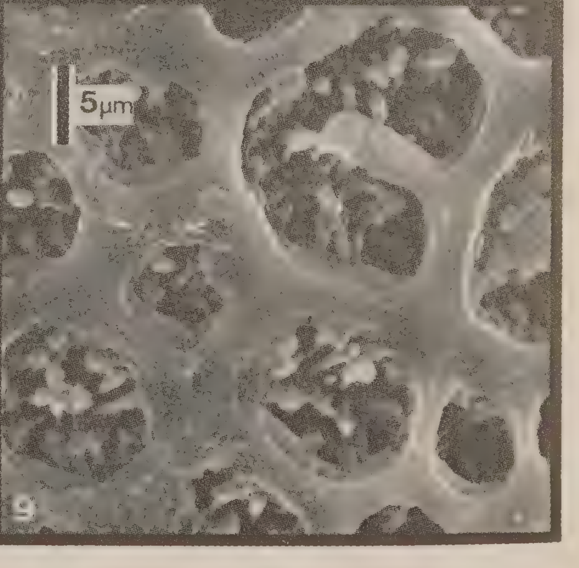
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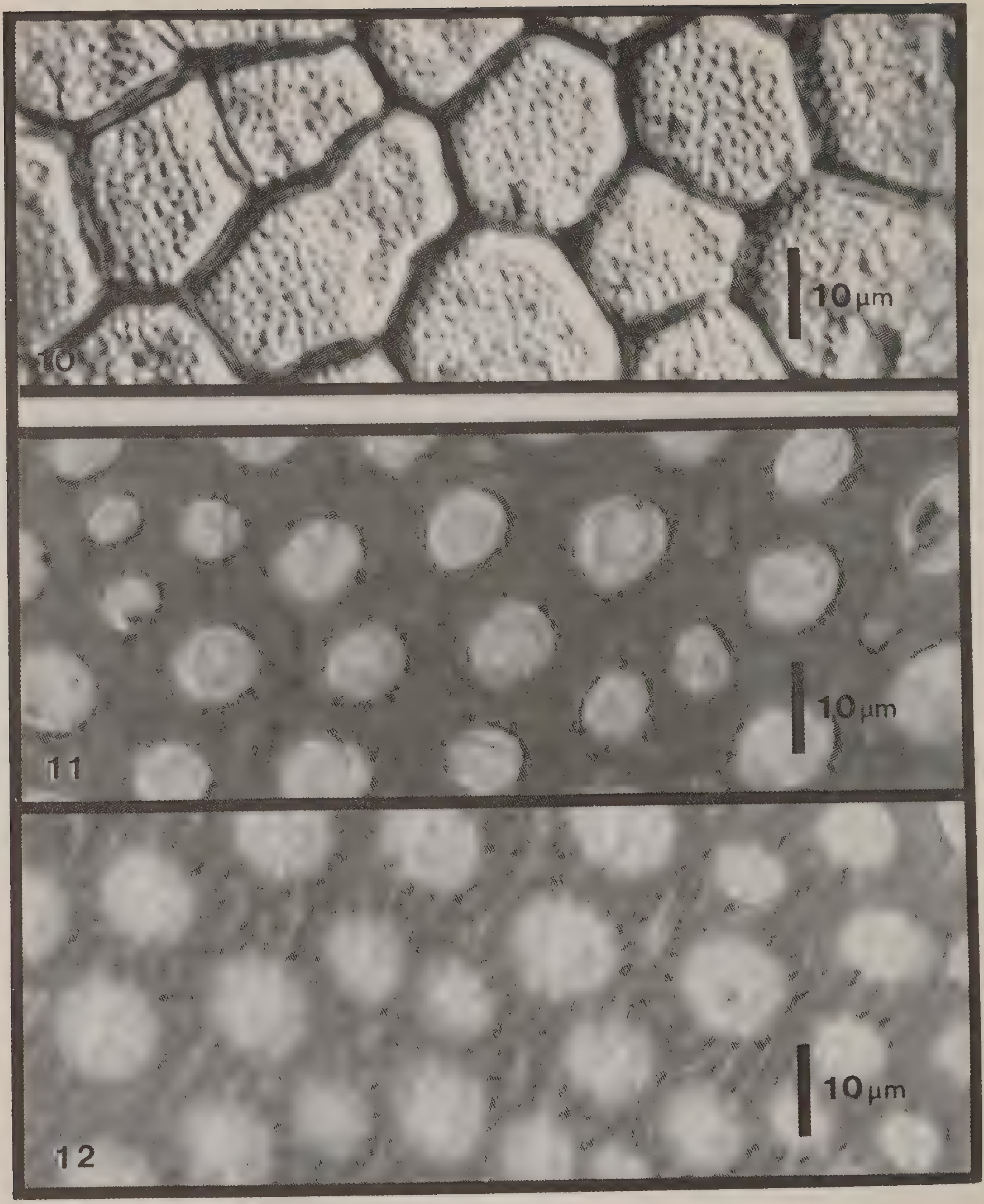

FIGURES 10-12. Light microscopy of outer wall-layers of *Gigaspora reticulata* (Figure 10) and *G. nigra* (Figures 11 and 12). Figures 11 and 12 show the even, rounded holes in the outer wall of the latter. Figure 10 shows the difference between the reticulate outer covering of the former and the apparently sinuous nature of the wall of *G. nigra* beneath the outer wall. This can be compared with the spines and ridges evident on *G. reticulata* in Figure 10.

than 0.5 um diam; the ridges 0.5-1 x 1-7 um at the base, tapering to a rounded edge less than 0.5 um wide. Middle layer hyaline to pale yellow, 5-11 um thick, tightly adherent to the thin, hyaline inner layer that is 0.3-0.7 um thick. Reticulate ridges on outer wall supporting a detachable alveolate reticulum 0.5-2 um wide and 2-6 um high. Inner wall group three-layered, consisting of membranous inner and outer hyaline layers each 1 um thick, connected by a hyaline amorphous middle layer 2 um thick. Outer and inner layers separating before germination to form a complex, circular to reniform germination shield, 94-156 x 156-208 um, from which germ tubes arise near the spore base.

Suspensor-like cell 45-87 x 84-140 um, with a peg-like protrusion extending 10-20 um towards the spore wall. Wall of suspensor-like cell laminated, orange-brown to red-brown, 3-5 um thick except near the spore-base where it thickens to 7-10 um; in some specimens, consisting of two distinct laminated layers, the inner layer 1.5-3 um thick, orange-brown to red-brown, the outer layer 2-7 um thick, hyaline to pale yellow.

Vesicles in the soil forming in clusters of 10-40 on somatic hyphae or around the suspensor-like cell, dark brown to red-brown, 25-30 x 30-40 um, with blunt, knobby projections 4-8 x 2-6 um.

Forming endomycorrhizae with arbuscules.

DISTRIBUTION AND HABITAT: Known from coastal sand dunes at the boundary with a saltmarsh, Sand Hill Cove, Rhode Island, and from a barrier sand dune at Moonstone Beach, Rhode Island. Also found in a Montauk soil (coarse-loamy, mixed mesic Typic Fragiochrepts (Soil Survey Staff, 1975)) in an orchard at Belchertown, Massachusetts. Associated, but not proved mycorrhizal, with roots of Phragmites communis Trinx, Ammophila breviligulata Fern., Myrica pensylvanic Loisel., Malus domestica Borkh., Prunus persica (L.) Batsch., Dactylis glomerata L., and Agropyron repens (L.) Beauv.

MYCORRHIZAL ASSOCIATIONS: Forming arbuscular mycorrhizae in greenhouse pot cultures with Sorghum sudanese (Piper) Staph. and Coleus x hybridus. Attempts to induce mycorrhizal formation with Allium sativa L. cv Agway sweet spanish, Zea mays L. cv seneca chief, and Malus domestica were not successful.

ETYMOLOGY: Latin, *reticulata*, referring to the prominent reticulate outer wallcovering of the spores.

COLLECTIONS EXAMINED: HOLOTYPE: RHODE ISLAND - Washington County, Sand Hill Cove, in rhizosphere of *Phragmites communis* on a sand dune. Collected 23 iii 1981 (Koske Collection # 286, Walker Accession # 379) (OSC; isotypes FH, K). PARATYPE: MASSACHUSETTS - Hampshire County, Belchertown, University of Massachusetts Horticulture Research Farm. Collected 13 viii 1980 (Miller accession # 56, Walker # 321) (OSC, ISC). OTHER COLLECTIONS: RHODE ISLAND, Washington County, Sand Hill Cove sand dunes, 4 iv 1979 collected by E. Ovsenik (Koske # 239): RHODE ISLAND - Washington County, Moonstone Beach sand dune, 9 ix 1978 (Koske # 201). In addition, specimens from pot cultures established with sorghum and coleus have been examined. Besides the specimens lodged in herbaria, samples have been retained in the collections of each suthor.

Gigaspora reticulata is readily distinguishable from other species in the genus by the prominent dark reticulum covering the spore surface. Only *G. nigra* J. F. Redhead in Nicolson & Schenck could be confused with *G. reticulata*, but these two differ distinctly. *G. reticulata* has globose to subglobose spores 188-340 x 208-470 (mean 264 x 281) um, considerably smaller than spores of *G. nigra*, which are globose and 297-1050 (mean 402) um in diameter. In addition, spores are much darker than those of *G. reticulata* , being dark brown to black compared with orange-brown to dark red-brown. The main difference between the species, however, is in the wall structure. *G. reticulata* has an outer wall covered by rounded spines and ridges that are contained, but not overlain, by a polygonal reticulum with ridges 0.5-2 um wide and meshes varying from 2 x 2 to 24 x 30 um across (Figure 10). The inner wall-group of *G. reticulata* consists of two membranous walls apparently fastened together by an amorphous middle layer. *G. nigra*, in contrast, has a distinct outer wall pitted by rounded pores 7-10 um diam, overlaying a second wall made up of coiled elements (Nicolson & Schenck, 1979; Old et al., 1973) that appear as densely packed, sinuous rods by light microscopy (Figures 11 and 12). The inner wall-group in this species consists of a continuous, laminated wall surrounding two thin, membranous walls.

G. reticulata spores tend to lose their suspensor-like cells during sieving from the soil and can then be confused with spores of fungi in the genus Acaulospora. The resemblance of this species to A. bireticulata Rothwell & Trappe is particularly striking, and the plates in Rothwell and Trappe (1979) and Walker and Trappe (1981) (Figure 2 amd Figure 12, respectively) are almost indistinguishable from Figures 7, 8, and 10 in this paper. Care should therefore be taken when identifying spores in this group to verify the nature of the attached hyphae.

ACKNOWLEDGMENTS: We thank Dr. William J. Lord, Extension Pomologist, University of Massachusetts, who kindly allowed the collection of samples at the Massachusetts Horticultural Research Farm; E. Ovsenik for collecting one of the sand samples from Rhode Island; and Don Scales for the scanning electron microscopy. We also thank Dr. N. C. Schenck and Dr. J. M. Trappe for their helpful comments. Dr. Trappe prepared the Latin diagnosis. Dr. Francis Sanders suggested the term "germination shield" and kindly permitted its use in this description.

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MYCOTAXON

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A NEW THERMOPHILIC SPECIES OF *MYCELIOPHTHORA*

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SUMMARY

A new hyphomycete, *Myceliophthora hinnulea* Awao & Udagawa isolated from cultivated soil in Japan, is described. The species is typically thermophilic, with a minimum growth temperature somewhat below 20 C, an optimum between 40 and 45 C, and a maximum somewhat above 50 C.

In the course of a study of thermophilic fungi in Japan (Awao and Mitsugi, 1973; Awao and Otsuka, 1973, 1974), a hyphomycete belonging to the genus *Myceliophthora* was isolated from cultivated soil. It differs from previously described species by having dull red to grayish brown colonies and brownish conidia with a conspicuously verrucose to spinulose surface.

Myceliophthora hinnulea Awao & Udagawa, sp. nov. (Fig. 1)

Coloniae in agaro cum decocto tuberorum ad 40 C effusae, paene planae, constantes ex mycelio basali tenui et conidio abundanti, velutinae vel plus minusve floccosae, primo albae vel roseo-vinaceae, dein griseo-brunneae vel hinnuleae, ad marginem tenues et late submersae; reversum brunneum vel hinnuleum vel griseo-sepiaceum.

Mycelium ex hyphis hyalinis, ramosis, laevibus, septatis, 1.0-5.0 (-6.5) µm diam compositum; hyphae fertiles plerumque aeriae, dense ramosae, 1.5-3.0 µm diam. Cellulae conidiogenae in hyphis gerentes, terminales vel laterales, sessiles vel saepe brevipedicellatae, ad apicem saepe inflatae usque 4.0-6.0 × 3.0-4.0 µm et ampulliformes. Blastoconidia plerumque 1-4 per cellulam conidiogenam, solitaria vel in 2-3 catenata, primo hyalina vel dilute flava et laevia, dein flavo-brunnea vel brunnea, incrassata, subglobosa vel ovata vel pyriformia, (7.0-)8.0-9.0 (-12.0) × (5.0-)6.0-7.5(-10.0) µm, ad basim cum contractis cicatricibus, irregulariter et conspicue verrucosa vel spinulosa; spinae usque 1.0-4.0 µm longae.

Holotypus No. AJ-6773, isolatus e solo sativo, Nirayama, Shizuoka, in Japonia, in 24.ii.1973, leg. T. Awao. In herb. NHL.

Etymology: lat. *hinnuleus* = fawn, referring to the colony color.

Colonies on potato-dextrose agar growing very rapidly, attaining 7.8-8.0 cm diam within 3 days at 40 C and more than 8.5 cm diam within 10 days, almost plane, consisting of a thin basal felt of vegetative mycelium and abundant conidia-bearing structures, velvety to more or less floccose, loosely covered with rather sterile aerial hyphae, at first white to dull red such as Aurora (M. 10B4; cf. Kornerup and Wanscher, 1978) or Rosy Vinaceous (Rayner, 1970), becoming grayish brown (M. 7D3) or Fawn (Rayner, 1970) in age; margin thin and broadly submerged; exudate limited, clear to pale yellow; reverse brown (M. 6E4) or Fawn to Grayish Sepia (Rayner, 1970).

Mycelium composed of hyaline, branched, smooth-walled, septate, 1.0-5.0(-6.5) µm diam hyphae; fertile hyphae mostly aerial, often densely branched, 1.5-3.0 µm diam. Racquet hyphae absent. Conidiogenous cells borne terminally or laterally as side branches on hyphae, often with short or long pedicels which are terminally inflated into ampulliform swellings measuring 4.0-6.0 × 3.0-4.0 µm. Blastoconidia usually 1-4 borne on ampulliform swellings, occasionally on short protrusions, solitary or in chains of 2-3, at first hyaline to pale yellow and smooth-walled, becoming yellowish brown to brown, thick-walled, subglobose to ovate or pyriform, (7.0-)8.0-9.0(-12.0) × (5.0-)6.0-7.5 (-10.0) µm, with narrow basal scars, irregularly and conspicuously verrucose to spinulose; spines up to 1.0-4.0 µm in length.

Colonies on YpSs agar growing very rapidly, attaining 7.5-7.7 cm diam within 3 days at 40 C and more than 8.5 cm diam within 10 days, with surface appearing more floccose, producing abundant conidia on the basal felt and aerial hyphae, at first white to reddish gray (M. 8B2) or Pale Vinaceous (Rayner, 1970), later becoming dull red to grayish brown (M. 8D3 to M. 9C4) or Vinaceous Buff (Rayner, 1970); exudate more abundantly, mostly as small droplets adherent to the mycelium, clear to pale yellow; reverse brown (M. 6E5) or Umber (Rayner, 1970).

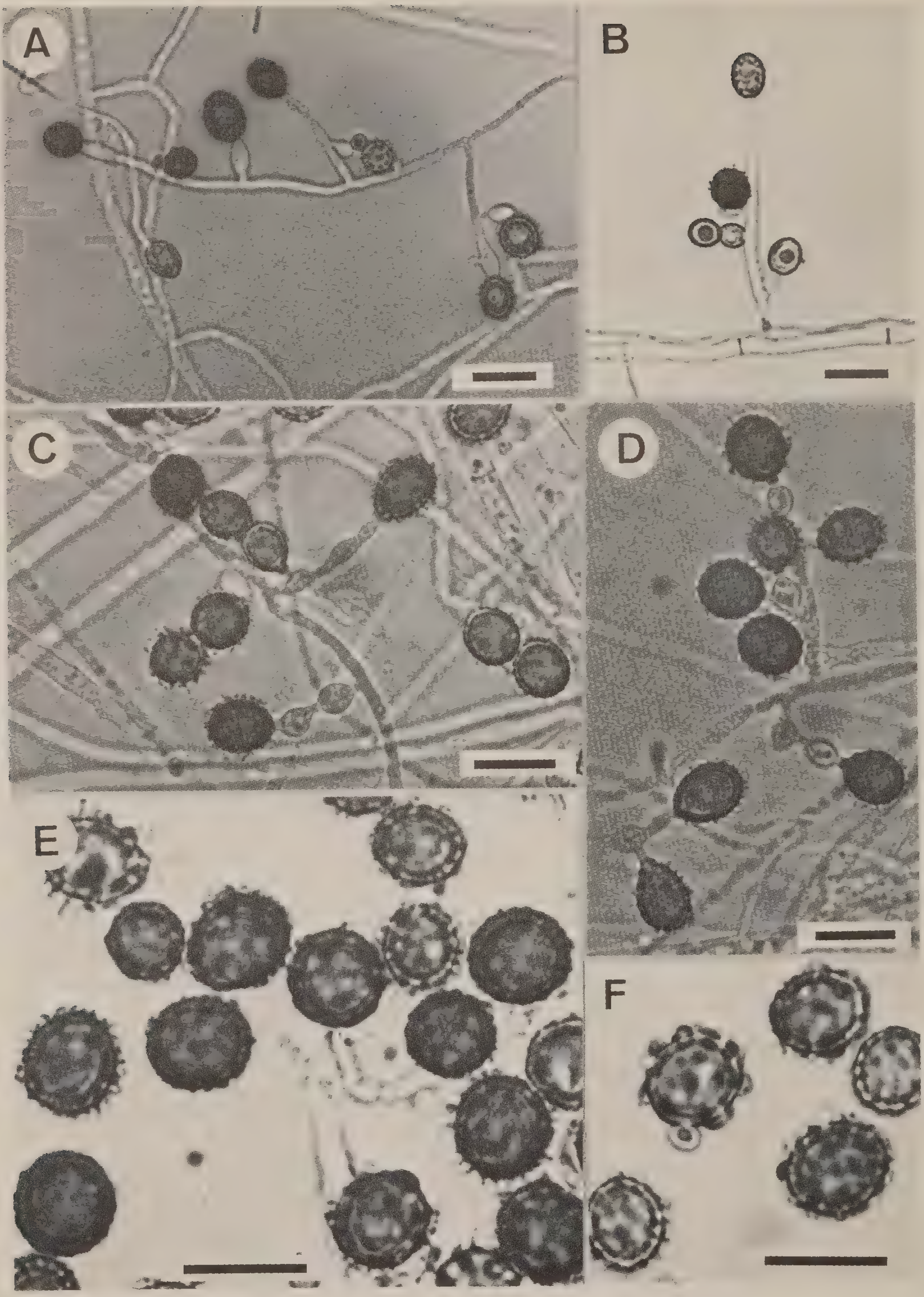

Fig. 1. Conidiogenous cells and conidia of *Myceliophthora hinnulea*, AJ-6773 strain.
A-D: conidiogenous cells. E, F: Conidia. (All scale-lines: 10 µm.)

Cellulolytic, but not distinctly keratinolytic.

Thermophilic with optimal growth at 40-45 C, minimum somewhat below 20 C, maximum somewhat above 50 C (Table 1).

Table 1. Radial growth and conidia formation of *Myceliophthora hinnulea* strain AJ-6773 at various temperatures

Temperature (C)	Growth, PDA		Conidia, PDA		Growth, YpSs		Conidia, YpSs	
	3d	10d	3d	10d	3d	10d	3d	10d
17	0	0			0	0		
20	0	3		±	0	5		±
25	10-12	65-67	-	+	12-14	65-70	±	+
30	25-26	>85	+	++	28-29	>85	+	++
35	61-63	>85	++	+++	59-60	>85	++	+++
40	78-80	>85	+++	++++	75-77	>85	++	+++
45	80-85	>85	++++	++++	72-75	>85	++	+++
50	48-50	>85	+	++	42-45	>85	±	++
55	0	0			0	0		

Growth: colony diam (mm) after 3 and 10 days.
Conidia: ++++, very abundantly produced; +++, abundant; ++, moderate; +, slight; ±, very slight; and -, not produced.

Isolation: cultivated soil, Nirayama-machi, Tagata-gun, Shizuoka-pref., Japan, 24 Feb. 1973, coll. T. Awao, No. AJ-6773 (holotype). The specimen studied is preserved at the Mycological Herbarium, National Institute of Hygienic Sciences, Tokyo (NHL). Subcultures of AJ-6773 have been deposited with the American Type Culture Collection (ATCC) and the Centraalbureau voor Schimmelcultures (CBS).

The genus *Myceliophthora* was reintroduced by van Oorschot (1977) to accommodate three *Chrysosporium*-like hyphomycetes possessing blastoconidia with narrow basal scars and often with the remains of ampulliform swellings produced as a supporting cell. Among these, two have been known as the anamorphs of two thermophilic Ascomycetes, viz. *Thielavia heterothallica* Klopotek and *Corynascus thermophilus* (Fergus & Sinden) Klopotek. She has, more recently in her taxonomic revision of *Chrysosporium* and allied genera (van Oorschot, 1980), added five species and provided a key to species currently accepted in the genus. Almost all hitherto known species are more or less thermotolerant or thermophilic, with sporulation often being good between 30 and 40 C.

Myceliophthora mostly closely resembles *M. vellerea* (Sacc. & Speg.) van Oorschot and *M. thermophila* (Apinis) van Oorschot, the anamorph of *Thielavia heterothallica*. It differs from the former in the rich pinkish color of its young colonies and the rapid growth at high temperature, because the growth temperature of *M. vellerea* ranged between 10 and 30 C. On the other hand, maximum growth of *M. thermophila* occurs at temperature of 50 C (our examined strains of *M. thermophila*: CBS 117.65 and UAMH 2015 = Semeniuk No. 200-2). In this respect, the latter is much similar to the new species but there are some discrepancies in the colonies color and the conidial morphology such as shape and ornamentation. The conidia of *M. thermophila* differs also from those of *M. hinnulea* by the hyaline color. Finally, because of the conspicuously verrucose-spinulose character of conidia, *M. hinnulea* is distinct from the another thermophilic species, *M. fergusii* (Klopotek) van Oorschot, the anamorph of *Corynascus thermophilus*, and the other species having smooth conidia.

ACKNOWLEDGMENT

We would like to thank Professor Michael R. Tansey of the Indiana University for critically reviewing the manuscript.

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OPERCULATE DISCOMYCETES FROM RANA (NORWAY) 5. RHODOSCYPHA GEN. NOV. AND RHODOTARZETTA GEN. NOV.

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ABSTRACT

Rhodoscypha gen. nov. and *Rhodotarzetta* gen. nov. are described; *Rhodoscypha ovilla* (Peck) comb. nov., *Rhodotarzetta rosea* (Rea) comb. nov., and *Neottiella aphanodictyon* (Kobayasi) comb. nov. are proposed. Delimitation of the genera *Leucoscypha*, *Neottiella* and *Rhodoscypha* is briefly discussed.

INTRODUCTION

During the 6th European Mycological Congress 1974 in Avignon, France the idea was presented that *Peziza ovilla* Peck is identical with *Humaria rhodoleuca* Bres. (Dissing 1975). From the beginning of our joint studies of the flora of Pezizales in the municipality of Rana, Norway (cf. Dissing & Sivertsen 1975) we have considered it necessary to propose a new genus for this taxon. A formal proposal of the new genus *Rhodoscypha* has until now been postponed because we wanted definitive results from cytochemical analyses of carotinoid pigments that clearly supported a separation of *Rhodoscypha ovilla* and species of the genus *Neottiella* (Cooke) Sacc.

Such evidence is hardly obtained by the preliminary results presented here, but new descriptions and proposals are the result of our desire to incorporate these new taxa in a proper way in the coming flora on "Nordic Macromycetes, order Pezizales".

MATERIALS AND METHODS

Fresh material of *Rhodoscypha ovilla*, *Rhodotarzetta rosea*, and *Neottiella aphanodictyon* has been studied. Dried material has been supplied by the following museums and herbaria: Botanical Museum, Copenhagen (C), Plant Pathology Herbarium, Cornell University, Ithaca (CUP), Rijksherbarium, Leiden (L), Herbarium, The New York Botanical Garden, New York (NY), Herbarium, New York State Museum, Albany (NYS), Botanical Museum, Oslo (O), Department of Botany, Panjab University, Chandigarh (PAN), Swedish Museum of Natural History, Stockholm (S), Institute of Zoology and Botany, Tartu (TTA), Museum of the Royal Norwegian Society for Science and Letters, Trondheim (TRH), and The Herbarium, Institute of Systematic Botany, University of Uppsala (UPS). Madam F. Candoussau, Pau, France, generously supplied material from her private herbarium.

Treatment of the material is in accordance with Dissing & Sivertsen (1980:101).

Rhodoscypha Dissing & Sivertsen *gen. nov.*

Carposoma disciforme vel cupulatum margine prominente, sessile vel substipitatum, extra pilis flexuosis membranis distromaticis vestitum; hymenium roseolum, raro albidum.

Excipulum omnino textura intricata, extra pilis obtusis saeptatis ramificatis vestitum membranis interioribus tenuibus aequalibus, exterioribus crassis inaequalibus tincturam Cotton Blue et t. carmineam declinantibus.

Asci operculati, non amyloides, maturi non prominentes. Paraphyses saeptatae, supra ramificatae, infra anastomosantes, cellula cujusque apicali guttulas exiguas numerosas continente.

Sporae uniseriatae, magnae, fusiformes, laeves vel verrucis subtilibus solitariis ornatae, quaeque guttulas primum duas magnas, matura numerosas minores continens.

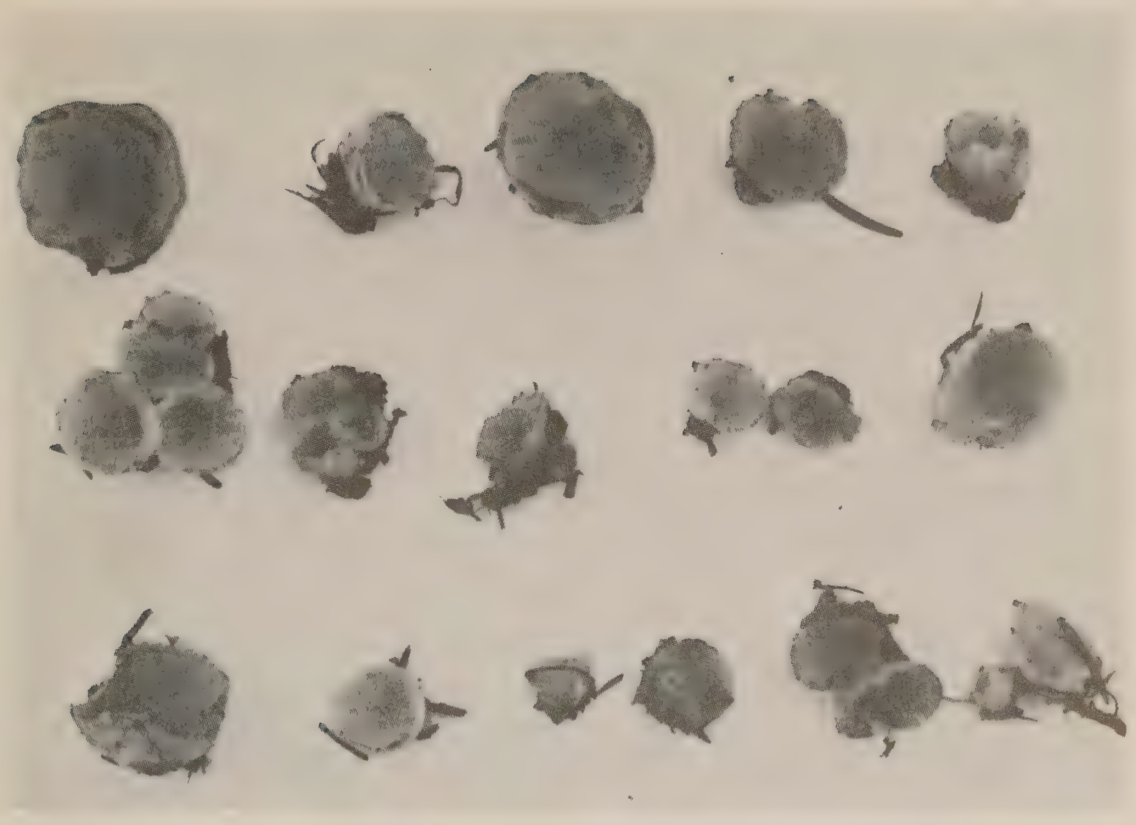

Figure 1. *Rhodoscypha ovilla.*
Fruit bodies. MO 75.81 (TRH). × 1.

Nuclei omnes tincturam carmineam captantes, in sporis unici, alibi singuli - 7ni.

Habitat in humo vel frustulis plantarum, raro in ligno.

Species typifica Rhodoscypha ovilla (Peck) Dissing & Sivertsen *comb. nov., basionyma Peziza ovilla* Peck 1875 (1876) p. 66.

Fruit bodies disc-shaped or cup-shaped, with prominent margin; hymenium pinkish, rarely whitish, outside with flexuouse hairs with two-layered walls. Sessile or substipitate.

Excipulum throughout of textura intricata; outside with septate, branching, blunt hairs with a thin, regular inner wall and a whitish, thick, irregular, cyanophobic and carminophobic outer wall.

Asci operculate, non amyloid, not protruding when mature. Paraphyses septate, branching above, anastomosing below, in the uppermost cell with numerous small guttules.

Spores uniseriate, large, fusiform, smooth or delicately ornamented with isolated warts, at first with two large guttules, when mature with numerous smaller ones.

All cells with carminophilic nuclei; spores uninucleate, other cells with one to seven nuclei.

On soil or plant debris, rarely on wood.

Type species *Peziza ovilla* Peck.

DISCUSSION

Harmaja (1977) included *Peziza ovilla* in the genus *Leucoscypha* Boud. emend. Rifai (1968). Svrček (1974) did the same by including the synonymous species *Humaria rhodoleuca* Bres. Harmaja correctly argued that cytologically, *i.e.* the carminophilous nuclei of the spores and other cells and in excipular anatomy *Leucoscypha leucotricha* (Alb. & Schw. ex Fr.) Boud., the type species of *Leucoscypha*, and *P. ovilla* are much alike.

On the other hand we find the two species differing significantly in a number of other characters, viz. the hairs, paraphyses, spores, and habitat, in a way which justifies the proposal of the above new genus *Rhodoscypha* for *Peziza ovilla*.

In *L. leucotricha* the hairs are stiff, with two well-defined regular layers in the wall, in *P. ovilla* the inner layer is thin and regular, while the outer layer is unique among the Pezizales in being extremely thick, irregular, of an amorphic, unstainable substance. The paraphyses in *P. ovilla* often have the uppermost cells densely filled with numerous refractive, pale reddish brown guttules. In *L. leucotricha* there are a few, colourless guttules in the uppermost cells. In *Leucoscypha* species the spores are permanently uni- or biguttulate, in *P. ovilla* they are at first biguttulate, then multiguttulate.

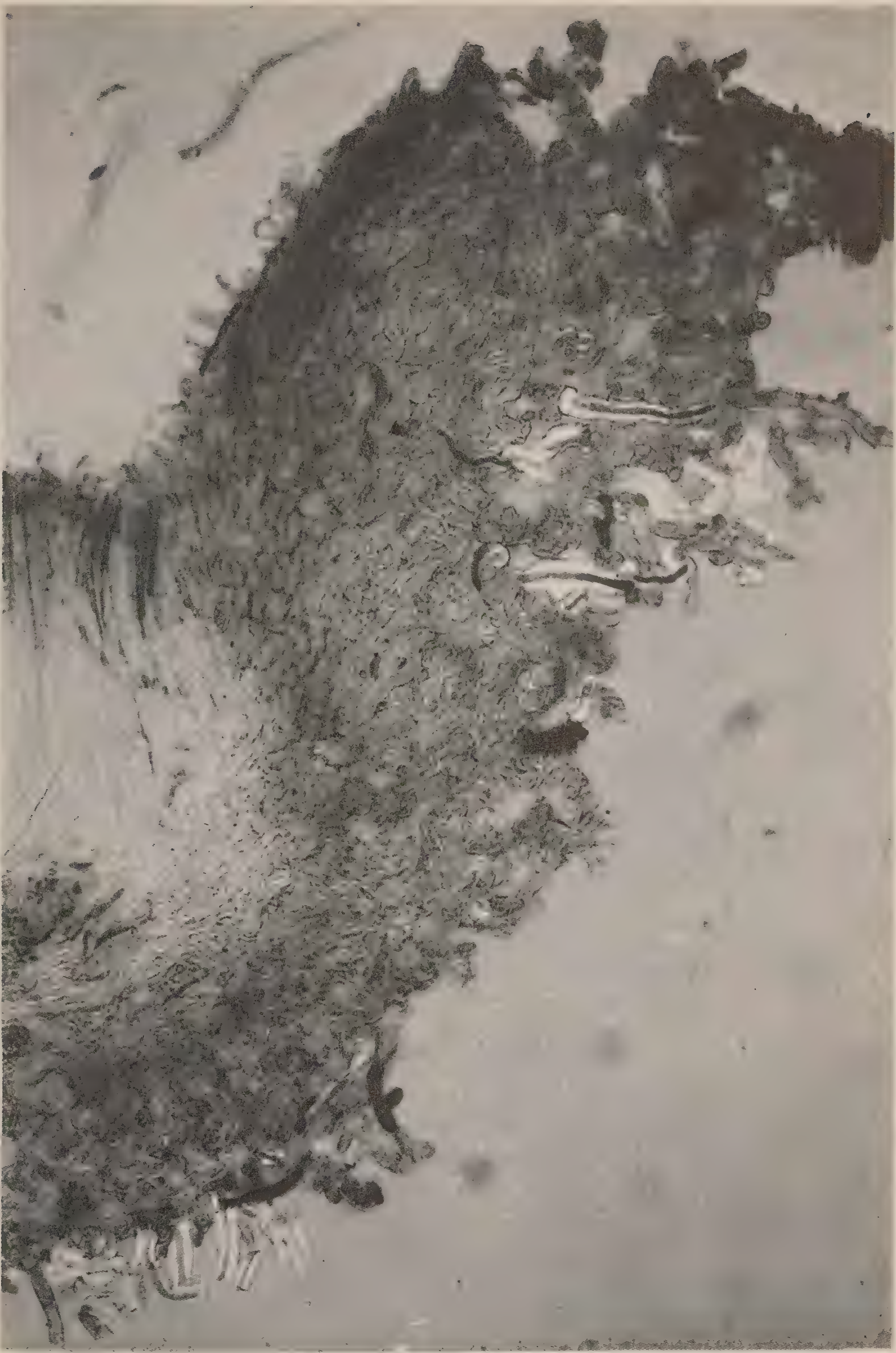

Figure 2. *Rhodoscypha ovilla.*
Marginal section in Cotton Blue. MO 73.73 (C). × 200.

Finally *P. ovilla* may be characterized as a calciphilous, montaneus (Svrček 1974) and subarctic species, while *L. leucotricha* mainly is confined to acid soil in temperate areas.

Rifai (1968) and Eckblad (1968) independently circumscribed the genus *Leucoscypha* in a way which included species of the genus *Neottiella* (Cooke) Sacc. Species from these genera have the same excipular anatomy, whitish hairs on the outside, and carminophilous nuclei in spores and other cells. On the other hand they differ significantly in at least a couple of other features, viz. cytochemistry and biology.

Arpin (1969) showed *Neottiella rutilans* (Fr.) Dennis to possess β- and γ-carotenes as the quantitatively most important pigments. To our knowledge no similar analyses have been performed for *L. leucotricha*, but it appears unlikely that the above pigments, or others characteristic for *N. rutilans* (Arpin, l.c.:104) would be demonstrated in *L. leucotricha*. As pointed out above *L. leucotricha* is confined to acid substrates, often on bare soil, while *N. rutilans* and its allies always are associated with mosses, mostly species of *Polytrichum*.

It should be noted that in our preliminary analyses of pigments in *R. ovilla* (Hammerness, MO 79.60) made by thin-layer-chromatography and spectrophotometry, it was possible to demonstrate four different, unidentified, pigments. Quantitatively most important was a winered to carmin pigment with an absorbtion maximum at 490 nm. It was not possible to demonstrate β- and γ-carotenes. *N. rutilans* served as reference material.

In spite of the mentioned similarities between taxa treated by others as *Leucoscypha* species we prefer to consider the smaller, more natural genera *Leucoscypha* Boud., *Neottiella* (Cooke) Sacc. and *Rhodoscypha* Dissing & Sivertsen.

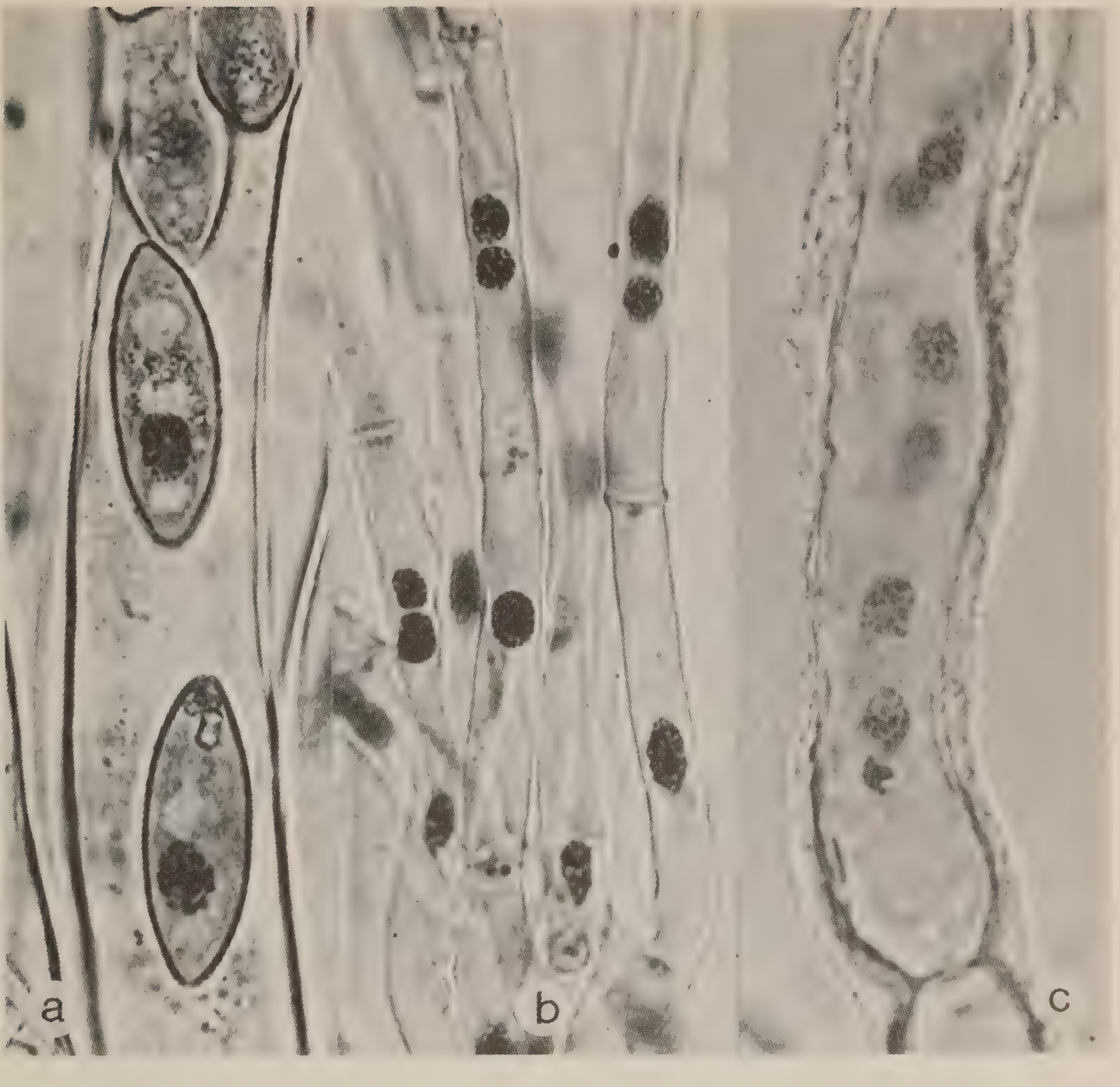

Figure 3. *Rhodoscypha ovilla*.
Nuclei in carminoaceticacid. a. Spores. b. Paraphyses. c. Hair. MO 73.73 (C). a-c, × 1085.

Rhodoscypha ovilla (Peck) comb. nov.

Peziza ovilla Peck, Ann. Rep. N.Y. State Mus. 28:66, 1875 (1876).
Neottiella ovilla (Peck) Sacc., Syll. Fung. 8:194, 1889.
Patella ovilla (Peck) Seaver, The North American Cup-fungi (Operculates):163, 1928.
Leucoscypha ovilla (Peck) Harmaja, Karstenia 17:73, 1977.
Humaria rhodoleuca Bres., Fungi Trid. II:79, 1892.
Pustularia rhodoleuca (Bres.) Boud., Hist. Class. Discom. d'Eur. 53, 1907.
Leucoscypha rhodoleuca (Bres.) Svrček, Česká Mykol. 28:132, 1974.
Figures 1-5 & 7.

Fruit bodies 0.5-1 cm broad, solitary or in small clusters, at first globose with an irregular, slit-like opening, later expanding, disc-shaped to cup-shaped, hymenium pinkish, rarely whitish, margin prominent, crenulate, irregularly dentate, whitish, outside covered by a dense mat of short, whitish hairs; sessile or substipitate.

Outer excipulum of textura intricata, individual cells 10-20 µm broad, interwoven, content staining blue in Cotton Blue; towards the margin, the cells tend to form subparallel rows with the outermost cell club-shaped.

Medullary excipulum as the outer excipulum, cells densely interwoven, 10-15 µm broad, content staining weakly blue in Cotton Blue. There is no sharp delimitation between outer and inner excipulum.

Hairs 150-230 µm long, 15-17 µm broad, flexuous, blunt, with two-layered walls; outermost wall 5-6 µm thick, whitish, continuous, surface irregular, rough; innermost wall thin, regular; content of cells staining blue in Cotton Blue and yellowish in Melzer's reagents; the outermost wall do not stain in any of the reagents; hairs with few septa, branching and sometimes anastomosing, each cell with 1-7 carminophilous nuclei. Subhymenium 60-85 µm broad, of densely interwoven cells, some of which are staining heavily blue in Cotton Blue.

Hymenium 385-425 µm high; asci 14-17 µm broad, cylindric, thick-walled, non-amyloid, the operculum being circular, 5-6 µm broad; asci not protruding when mature.

Paraphyses septate, above branching, slightly enlarged to 4-5.3 µm broad, below anastomosing; in fresh specimens the uppermost cell has numerous small pale reddish brown guttules; each cell in the paraphyses has 2-4 (rarely 1 or 5-6) carminophilic, subglobose to ellipsoid, nuclei, 2-4 × 5-7 µm.

Spores uniseriate, 33-39.7-46.2 × 10-13.4-16.5 µm, fusiform, much varying in size and shape, with one, 6-8 µm broad, carminophilous nucleus; spores at first with two guttules, when mature with many small guttules, which in dried, rehydrated material merge into one large, central guttule. In the light microscope the spores appear smooth, but in the scanning electron microscope they prove to be very delicately ornamented with low isolated warts.

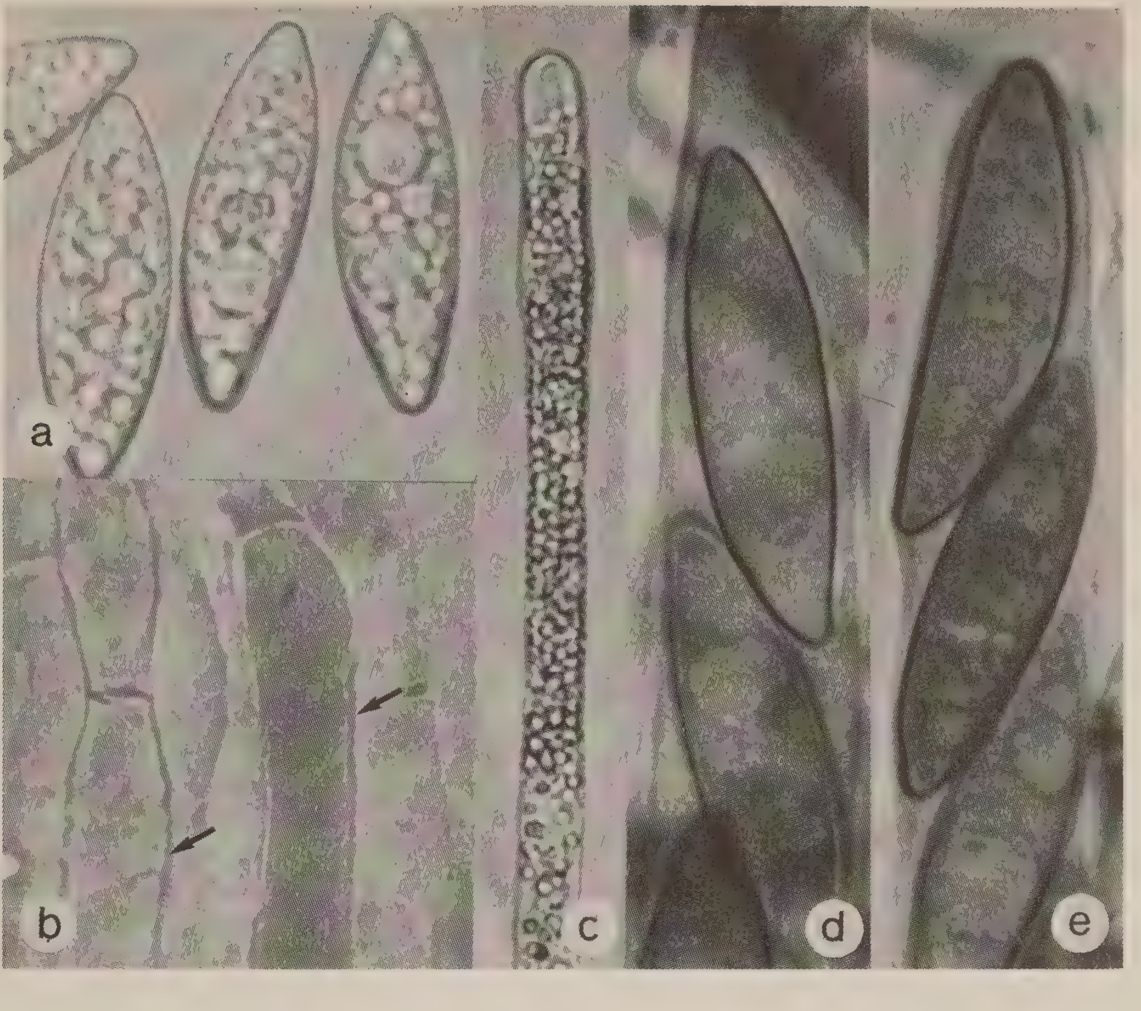

Figure 4. *Rhodoscypha ovilla.*
a. Mature spores from fresh material in H_2O. MO 75.61 (TRH). b. Hairs with thin inner wall (arrows) and thick outer wall, in 2% KOH. MO 73.73 (C). c. Paraphyses from fresh material, with numerous refractive guttules. MO 75.61 (TRH). d. Spores, in Cotton Blue, from type of *Peziza ovilla* (NYS). e. Spores, in Cotton Blue, from type of *Humaria rhodoleuca*, (S). a & c, × 800, b, d & e, × 1085.

MATERIAL

The above description is based mainly on the following collections which have been studied in detail:
Norway: Nordland, Rana, Store Alteren, map sheet 1927 I, VP 55, 9. September 1972, MO 72.137 (TRH); - ibid., 5 September 1973, MO 73.73 (C); - ibid., 8 September 1975, MO 75.61 (C,CUP,H,NY,NYS,O,S,UPS,TRH,ZT); - Ørtfjellmoen, map sheet 2027 IV, VP 86, 9 September 1975, MO 75.68 (TRH).

Additional collections:

Norway: Nordland, Rana, Store Alteren, 5 collections; - Ørtfjellmoen, 6 collections; - Hammerness, map sheet 1927 I, VP 56, 5 collections; - Ramnåga, map sheet 1927 I, VP 56, 1 collection, T. Schumacher; - Rausandaksla, map sheet 1927 I, VP 56, 1 collection; - Grønlia, map sheet 2027 IV, VP 66, 1 collection.

Sweden: Upland, Årentuna sn, Storvreta forest, N of the railway station, 10 August 1942, S. Lundell (UPS); - Västmanland, Sala, Gröna gången, close to Måns-Ols, 5 July 1945, R. Morander 89 (UPS).

Finland: Kuusamo, Liikasenvaara, lower course and mouth of the brook Sirkkapuro, 24 August 1978 (4 collections, incl. F.78.10 and F.78.11 (C)); - Juuma, The Vuomas, 25 August 1978 (C, TRH).

Estonian SSR: Rakvere, Neeruti, 4 September 1965, Raitviir (TAA 44121, C).

Switzerland: Graubünden, E of the bridge over the river Inn, 2 km SE of Ramosch, alt. 1100 m, 6 September 1979, Dissing (C).

France: Hautes Pyrénées, Le Chiroulet, Vallée de Lesponne, sous *Abies pectinata*, alt. 1100 m, 21 July 1974, F. Candoussau (C).

Italy: Trento, Tertiolasi, in silva abiegna, Junio 1880, leg. Bresadola, s.n. *Humaria rhodoleuca* Bres. n. sp. The handwriting on the label is Bresadola's (Type, ex herb. Bresadola, S); - Südtyrol, in pinetis, 1884, leg. Bresadola, s.n. *Peziza permuda* Cooke = *Pez. patavina* Sacc. The handwriting on this label is not Bresadola's (ex herb. Rehm, S).

U.S.A.: New York, Sagesville (= Lake Pleasent), August, C. H. Peck (Type, NYS, NY, slide); - Lloyd-Cornell Preserve, Slatersville, on bark of *Betula lutea* and very decaying wood, 4 October 1947, C.T. Rogersen & R.P. Korf (CUP 37139, C); - Wisconsin, Perry's woods, Algoma, Kewaunee County and vicinity, 16 August 1909, B.O. Dodge, s.n. *Humaria rhodoleuca* Bres. (NYS); - Alaska, Liberty Creek Trail near Chitine, in wet leaf mold under alder, 1 September 1963, P.E. Kempton # 9 (NY).

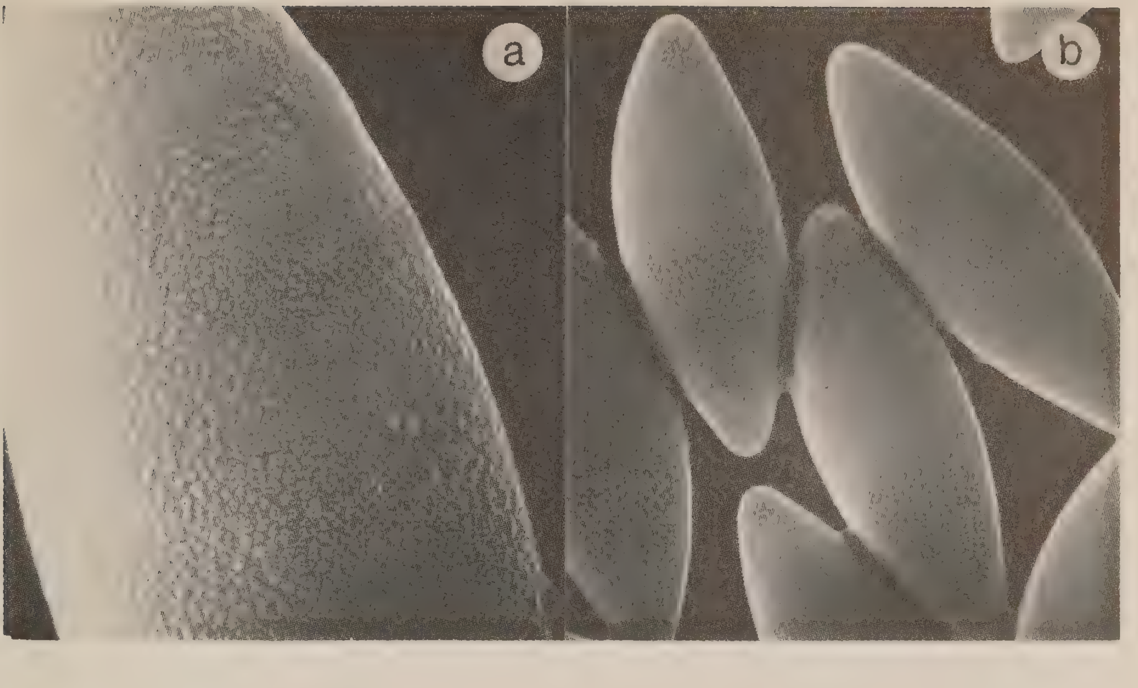

Figure 5. *Rhodoscypha ovilla.*
SEM photo of spores. MO 72.22 (TRH). a. × 4000.
b. × 1200.

India: Chankaphug, Thimhu, Bhutan, on soil in mixed forest of Blue Pine, Fir, Spruce and *Rhododendron*, alt. 9000 feet, 23 September 1980, R. Kaushal (PAN 18330, C); - Chuzom, Ha Dzong, Bhutan, on soil infested with mosses and mixed with forest litter in a mixed forest, alt. 10.000 feet, 1 October 1980, R. Kaushal (PAN 18364, C).

DISCUSSION

In the present investigation *Humaria rhodoleuca* Bres. is considered to be identical with *Peziza ovilla* Peck, with the latter name having priority (cf. Dissing 1975).

Harmaja (1977), on the basis of spore characters, viz. length, breadth, shape, content and thickness of the episporium, distinguished between the two taxa. He also paid attention to the substrate, *H. rhodoleuca* growing on soil, and *P. ovilla*, at least the material studied by him, growing on woody substrates.

However, the spore characters may vary considerably, even in the same fruit body, and at present we are not able to distinguish between two or more taxa. The results of some spore-measurements are summarized in Table 1. The variation in the number of guttules is described above.

One collection from Ørtfjellmoen (9 September 1975, (TRH)) was pure white, but otherwise typical. After treatment by an iron needle the touched and surrounding area changed very quickly to rust red. The same feature could be demonstrated on white specimens from Finland in 1978 (F.78.11 (C)).

Table 1. Spore-measurements in *Rhodoscypha ovilla*. 10 spores measured in each collection (indicated in µm).

Peziza ovilla, type, NYS	49.5-62.7 × 11.6-14.5
P. ovilla, Alaska, Kempton # 9	36.3-45.5 × 10.6-13.9
Rhodoscypha ovilla, Norway MO 75.61	33.0-46.2 × 10.0-16.5
R. ovilla, Finland F. 78.10	34.7-43.0 × 11.6-14.0
Humaria rhodoleuca Bres., type, S	48.2-56.1 × 10.6-13.9

The specimens examined by Harmaja (l.c.) from Finland were growing "on dead mossy logs of spruce (*Picea abies*)". However, the 5 collections found by Dissing (see above), also from the Kuusamo area in Finland, were fruiting on soil or soil mixed with plant debris, like all collections from Norway.

ECOLOGY

In Store Alteren, Norway (with 8 collections) *Rhodoscypha ovilla* is growing on a steep hill side in a mixed stand of *Picea abies* and *Sorbus aucuparia* with a very lush field layer consisting of *e.g. Aconitum septentrionale*, *Lactuca muralis*, *Origanum vulgare*, *Vicia sylvatica* and tall ferns (mostly *Matteuccia*). Hammernes (with 5 collections) is similar whereas most collections in Ørtfjellmoen (7 collections) have been made along the bed of an intermittent, steep brooklet. The bed rock is limestone, the surrounding vegetation is old, well-grown *Picea* forest with some *Betula*.

In order to illustrate some edaphic parametres three soil samples were taken. Collecting of the samples as well as measurements of pH and conductivity in the samples are in accordance with the methods described by Petersen (1967: 313-314). The results are summarized in Table 2.

Table 2. Edaphic factors for *Rhodoscypha ovilla*. Organic matter was determined as loss on ignition after 6 H at 400° C. Methods for measurements of pH and conductivity see Petersen (l.c.).

Collection number	pH	Lt(μS)	Loss on ignition (% of dry weight)
MO 75.68 A	6.8	380	36.7
MO 75.68 B	6.9	157	14.6
MO 73.73	5.2	470	8.1

Rhodotarzetta Dissing & Sivertsen *gen. nov.*

Carposoma primum hemisphaericum, deinde cupulatum vel disciforme, margine prominente, base lata sessile, extra glabrum, roseolum ut semper hymenium, vel albidum.

Excipulum omnino textura intricata, cellulis achrois, tincturam Cotton Blue intra paulum accipientibus. Subhymenium e cellulis dense intertextis formatum, cellulis uncificis tincturam Cotton Blue avide captantibus intermixtis.

Asci operculati, non amyloides. Paraphyses saeptatae, cellula cujusque apicali guttulas exiguas numerosas continente.

Sporae uniseriatae, laeves, ellipsoides, quaeque duas guttulas continens.

Habitat in locis deustis.

Species typifica Rhodotarzetta rosea (Rea) Dissing & Sivertsen *comb. nov., basionyma Pustularia rosea* Rea 1924, p. 20.

Fruit bodies at first hemisphaeric, then cup-shaped to disc-shaped, with a prominent margin; hymenium pinkish, outside glabrous, concolorous with hymenium or whitish; sessile on a broad base.

Excipulum throughout of textura intricata, cells colourless, with the content staining weakly blue in Cotton Blue.

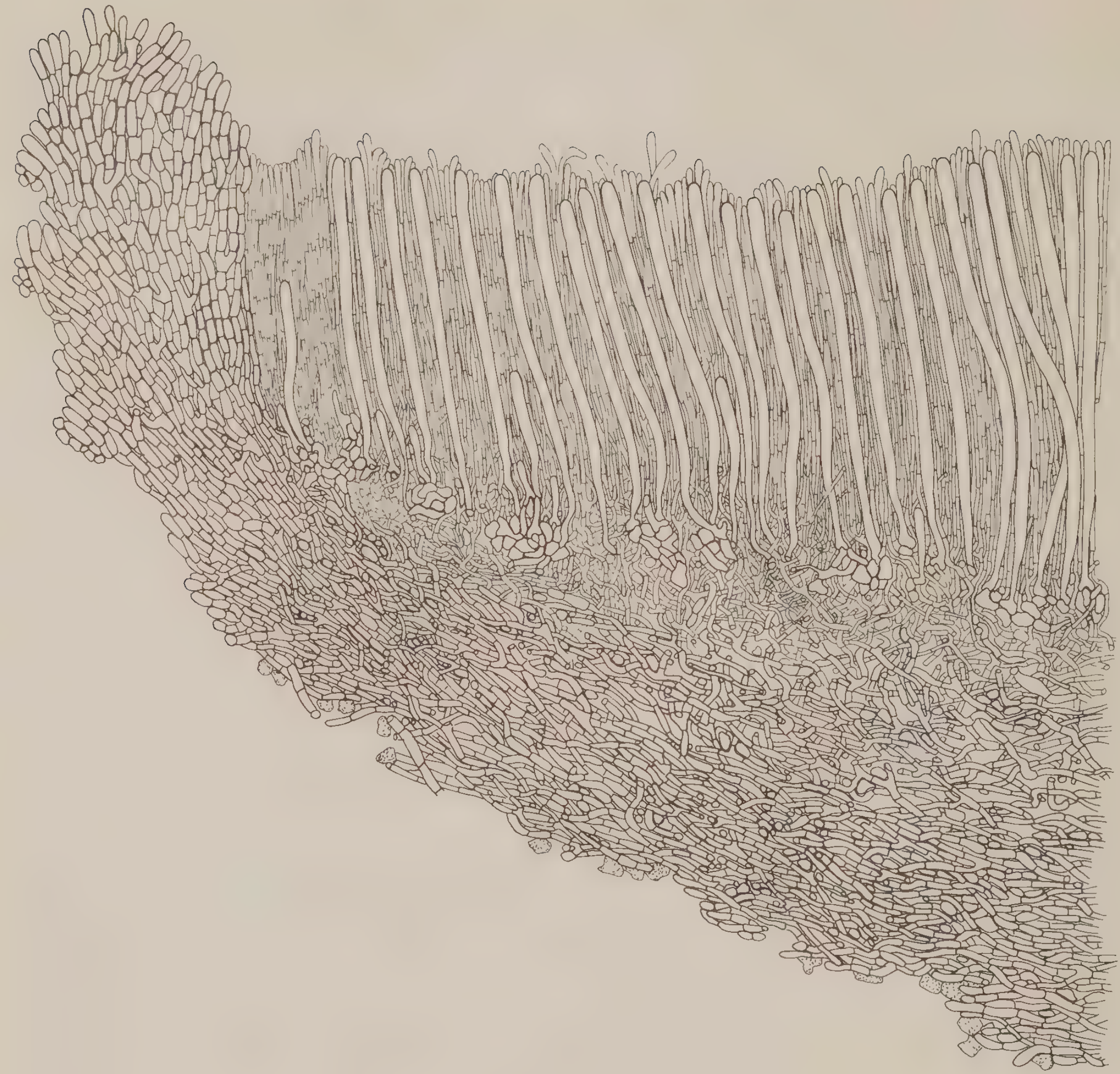

Figure 6. *Rhodotarzetta rosea*.
Marginal section. MO 75.81 (TRH,C). × 130.

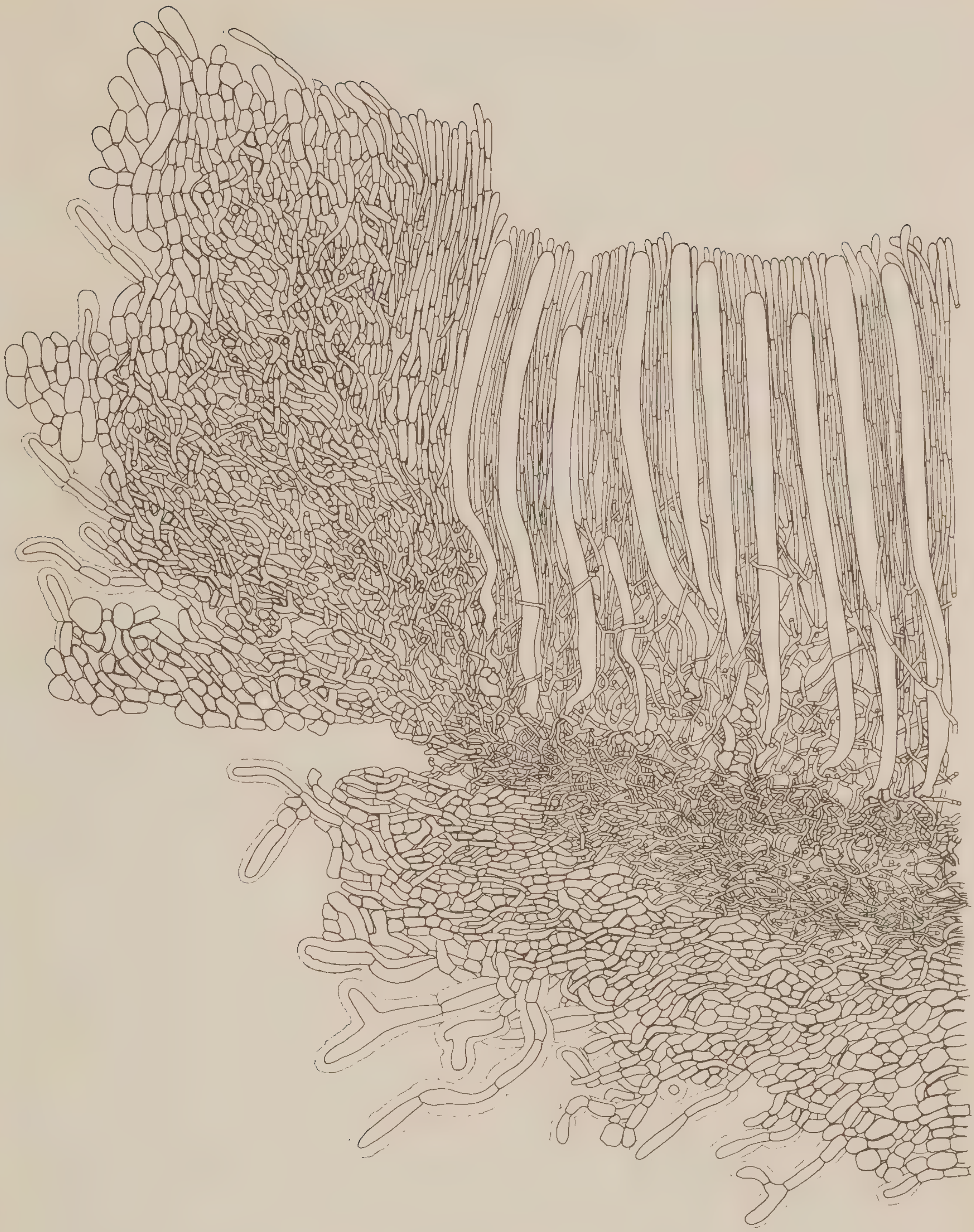

Figure 7. *Rhodoscypha ovilla*.
Marginal section. MO 73.73 (C). × 130.

Subhymenium of densely interwoven cells mixed with crozier-forming cells, deeply staining blue in Cotton Blue.

Asci operculate, non amyloid. Paraphyses septate, uppermost cell with numerous guttules.

Spores uniseriate, smooth, ellipsoid, with two guttules. On burnt areas.

Type species *Pustularia rosea* Rea.

DISCUSSION

Rhodotarzetta rosea differs from species in the genus *Tarzetta* (Cooke) Lamb. in having an excipulum which throughout is made up of textura intricata, in being glabrous, and in possessing pinkish pigments in the paraphyses.

In *Tarzetta* species the excipulum is clearly two-layered (cf. Eckblad 1968, Fig. 38 and Pant & Tewari 1970, Figs 1 and 17), the outside is furfuraceous, and all *Tarzetta* species so far described have whitish, cream or greyish pigments in the paraphyses. No *Tarzetta* species are confined to burnt areas.

Rhodotarzetta rosea (Rea) comb. nov.

Pustularia rosea Rea, Trans. Worcestershire Nat. Club 8:20, 1924.
Tarzetta rosea (Rea) Dennis, British Ascomycetes 30, 1978.
Figure 6.

Fruit bodies solitary or in small clusters, 0.4-1.2 cm broad, at first hemisphaeric, with a small circular opening, then cup-shaped to disc-shaped, with a prominent margin; hymenium pinkish, sometimes with a purplish tinge, when mature becoming pale orange; outside glabrous, concolorous with hymenium or whitish; sessile on a broad base.

Outer excipulum of textura intricata, 95-115 µm thick, individual cells 3-8.5 µm broad, densely interwoven, subparallel to outer surface, colourless, content staining blue in Cotton Blue.

Medullary excipulum also of textura intricata, of loosely interwoven cells, 5-11 µm broad, content staining weakly blue in Cotton Blue.

Subhymenium 30-65 µm thick, of short, densely interwoven cells, mixed with crozierforming cells, in which the content is staining deeply blue in Cotton Blue.

Hymenium 190-220 µm high; asci 11.6-13.2 µm broad, operculate, non amyloid.

Paraphyses septate, slightly enlarged above to 5 µm broad, uppermost cell with many small, reddish guttules.

Spores uniseriate, smooth, ellipsoid, with two guttules, 16.5-17.9-19.8 × 7.6-8.7-9.9 µm.

MATERIAL

Norway: Nordland, Rana, Ørtfjellmoen, map sheet 2027 IV, VP 86, burnt area in gravel pit, together with *Octospora rubens* (Boud.) Moser, 9 September 1975, MO 75.81 (TRH,C).

The description is based mainly on the above collection. In addition the following collections have been studied:

Denmark: Sjælland, Tureby, burnt area, 21 September 1964, P.M. Petersen & H. Dissing (C); - Jylland, Klosterhede Plantage, 8 km N of Struer, burnt area, 10 October 1969, P.M. Petersen (C).

Holland: Noord-Brabant, Groet Peel, 27 April 1961, P.B. Jansen, on burnt peat (L); - Drente, Dalen, 23 May 1961, on burnt peat, J.J. Barkman (L).

Neottiella aphanodictyon (Kobayasi) Dissing, Korf & Sivertsen comb. nov.

Aleuria aphanodictyon Kobayasi, Ann. Rep. Inst. Fermentation Osaka 3:39, 1967.
Leucoscypha borealis Eckblad, Nytt Mag. Bot. 15:52-53, 1968.

MATERIAL

Norway: Finnmark, Tana, Rustefjelbma, 22 July 1961, F.-E. Eckblad, 61.93 (Type of *Leucoscypha boreales*, O); - Nordland, Rana, Virvassdalen, map sheet 2027 I, VP 05, naked soil among scattered mosses, 12 August 1979, MO 79.15 (C), 79.96 (TRH); - ibid., 28 August 1981, 81.94 (TRH); - Jordbru, map sheet 2027 I, VP 85, 31 July 1974 (TRH); - Grunnvatn, map sheet 2027 III, VP 73, in inundation zone of reservoir 11 August 1979, 79.99 (TRH).

Greenland: Pâmiut, Frederikshåb, 62^0N, $49^0$06'W, among *Polytrichum*, 7 September 1979, T. Borgen 79.129 (C).

U.S.A.: Alaska, Barrow, "plot 419, US IBP Tundra Biome Sites, $71^0$17'N $156^0$41'E, on soil among mosses", 19 August 1974, O.K. Miller & G.A. Laursen 11831 s.n. *Aleuria aphanodictyon* Kobayasi (CUP 58835); - Alaska, Barrow, within walking distance from the Naval Arctic Research Laboratory, on soil among *Polytrichum*, 17 August 1980, H. Knudsen (A 22,C); - ibid., M. Lange (A 25,C); - ibid., 19 August 1980, R.P. Korf (AK 30, CUP; A 29,C); - ibid., 21 August 1980, Dissing & Sivertsen (A 41, A 42,C; - ibid., B 6,9,10, TRH).

DISCUSSION

The collections from 1980 were all made during the First International Symposium on Arctic Mycology held at Barrow, Alaska from 16-23 August where also Dr. Kobayasi participated. Although it seems as if the holotype of *Aleuria aphanodictyon* is lost we feel sure about the identity of this species. *A. aphanodictyon* possess all characters typical for *Neottiella* species, viz. soil inhabiting, associated to *Polytrichum* species, paraphyses with carotinoid pigments, guttulate spores with cyanophilic ornamentation, spores and other cells with carminophilic nuclei, excipulum of textura intricata, and with whitish flexuous or stiff hairs on the outside.

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BASIDIOMYCETES APHYLLOPHORALES EPITHELOIDES ETALES

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The presence of sterile pegs is not a suitable character to circumscribe a natural group. The fourteen species of warm countries studied (ten of which are new) are distributed among the genera *Epithele* (Pat.) Pat. emend., *Pteridomyces* Jülich emend. and *Vesiculomyces* Hagström emend. The main results are translated into English at the end of the paper.

Patouillard (1899) propose une section *Epithele* dans le genre *Hypochnus*, section caractérisée par des "émergences qui traversent l'hyménium et qui sont comparables à celles de *Mycobonia* et de *Veluticeps* dans le groupe des *Stereum* ou d'*Heterochaete* dans les Hétérobasidiés". Cette proposition fait suite à la description d'*Hypochnus dussii* qui est comparé à *H. typhae*.

En 1900, Patouillard élève *Epithele* au rang de genre, sans désigner le type, comme cela se faisait à l'époque. Il cite les deux mêmes espèces et figure *E. typhae*. *H. dussii* ayant été transféré par von Höhnel et Litschauer (1907) dans le genre *Peniophora*, *E. typhae* est devenu, en fait, le seul représentant et a été logiquement sélectionné comme type par divers auteurs (cf. Donk 1957).

Peu à peu des *Epithele* nouveaux ont été décrits par Bresadola, Burt, Rick, Cunningham et plus récemment par Boquiren (1971) dans une révision où l'on retrouvera citées toutes ces espèces. Mais comme pour *E. dussi* qui est actuellement un *Tubulicium*, les émergences de plusieurs espèces de prétendus *Epithele* sont en fait des cystides bien différenciées enrobées d'hyphes grêles; ces espèces n'ont pas leur place ici: *E. capitata* Rogers et Boquiren, *E. macrospora* (Liberta) Boquiren, *E. vermifera* (Bourd.) Boquiren.

Ces exclusions faites, la révision de Boquiren comprend 8 espèces auxquelles il faudrait ajouter 4 espèces créées par Rick et qui n'ont pas pu être réétudiées depuis lors.

On peut s'attendre à ce qu'un regroupement basé sur un seul caractère physionomique, la présence d'émergences stériles, crée un ensemble artificiel; Patouillard avait d'ailleurs souligné lui-même des émergences de même aspect chez les Hétérobasidiés et dans le "groupe des *Stereum*" ce qui s'explique par un phénomène de convergence et n'est donc pas un témoignage de réelle parenté.

Nous traiterons ci-après de 14 espèces, récoltées en zones intertropicales, 9 africaines, 2 malaises et 2 américaines, auxquelles il faut ajouter une espèce malgache très particulière avec ses spores amyloïdes et ses énormes Gloeocystides sulfoaldéhydes positives que nous ne pouvons éloigner du genre *Gloeocystidiellum* Donk *sensu lato* malgré ses émergences stériles. C'est un exemple complémentaire de convergence!

Jülich a successivement proposé 3 genres monospécifiques: *Epithelopsis* (1976), *Pteridomyces* et *Skeletohydnum* (1979), sans parler de *Mycothele* (1976) créé pour une espèce discoïde que Patouillard aurait assigné au "groupe des *Stereum*", et dont nous ne parlerons pas ici.

On peut dresser une clé schématique des genres étalés-adhérents en sélectionnant les caractères distinctifs puisés dans les descriptions génériques et spécifiques de Jülich. Tous les représentants sont pourvus de boucles et d'émergences stériles et, semble-t-il, d'éléments dendrophysoïdes.

- Structure monomitique :
  - . basides de 10-15 µm de longueur; émergences faites d'hyphes à paroi mince. *Pteridomyces* Jül.
    type: *E. galzinii* Bres.
  - . grosses podobasides longues de 55-70 µm; spores à paroi épaissie à maturité, non cyanophile. *Epithele* Pat.s.str.
    type select.: *E. typhae* (Pers.) Pat.

- Contexte dimitique, et émergences faites d'hyphes squelettiques.
  - . spores à paroi épaissie et cyanophile, gloeocystides. *Epithelopsis* Jül.
    type: *E. fulva* Cunn.
  - . spores à paroi mince non cyanophile. *Skeletohydnum* Jül
    type: *E. nikau* Cunn.

Aucune des 13 espèces à classer n'a de spores à parois cyanophile; elles devraient donc se répartir dans les genres *Pteridomyces*, *Epithele* et *Skeletohydnum* en fonction d'une part de la taille des basides, d'autre part du mitisme. Ce sont là deux critères quantitatifs ou progressifs. Le "mitisme" a été l'objet de bien des interprétations, divergentes; c'est ainsi qu'*Epithelopsis fulva* (Cunn.) Jülich est considéré par le premier auteur comme monomitique, par le second comme dimitique. Il faut rappeler que la notion de systèmes d'hyphes mono-, di-, et tri-mitiques est due à Corner qui décrivait ainsi dès 1932 la structure du contexte et des dissépiments de quelques polypores. (voir la mise au point de Corner 1953 par exemple).

Corner ne prend en compte ni le cortex et les hyphes de la face stérile, ni l'hyménium. Faut-il ou non prendre en considération les émergences stériles des Epithele s. lato ? Il faut en outre bien faire remarquer que la différenciation d'un deuxième système, fait d'hyphes squelettiques, c'est-à-dire d'articles terminaux longs et à paroi épaissie, peut être très affirmée ou au contraire encore peu marquée : ces deux cas ont été rencontrés dans notre étude. En fait nous avons observé les situations suivantes :

a- contexte et émergences faits uniquement d'hyphes génératrices: cas d'E. typhae et de P. galzinii, mais aussi d'E. macarangae n. sp. et efibulata n.sp., et de P. lacteus n.sp. et sphaericosporus n.sp.

b- émergences qui "naissant des parties profondes" comme l'écrit Patouillard (1900 p. 59) sont faites en grande partie d'hyphes squelettiques plus ou moins affirmées. Entre les émergences, parfois très rapprochées, le contexte ne montre que des hyphes génératrices (contexte monomitique): cas du Skeletohydnum nikau et des E. guadelupensis, malaiensis et ovalispora ainsi que de P. roseolus et P. sp. 8270.

c- émergences faites d'hyphes squelettiques,fibres nombreuses dans le contexte entre les émergences (contexte dimitique): ceci correspond à la définition du genre Skeletohydnum mais non à son type; c'est par contre le cas d'E. citrispora.

d- contexte dimitique à hyphes squelettiques dominantes mais émergences faites presqu'uniquement d'hyphes de type générateur associées à quelques hyphes axiales à tendance squelettique : cas d'E. sp. 5697.

e- contexte dimitique et émergences faites d'hyphes de type générateur: cas d'E. interrupta Bres.

Après ce constat on ne peut qu'hésiter à utiliser le mitisme pour des découpages qui seraient très certainement arbitraires. Par contre, on ne peut hésiter à répartir nos récoltes en deux groupes selon la forme et la taille des basides. Les unes ont de petites basides étroitement claviformes 14-20 x 3,8-5 µm, atteignant 30 µm de long chez le seul P. lacteus, sans contenu remarquable (groupe I). Les autres ont de grosses basides larges de 6-8 à 10-14 µm plus ou moins brusquement rétrécies à leur base, souvent plus larges dans leur partie moyenne ou même dans leur moitié inférieure, à (2)-4 forts stérigmates arqués, et au contenu riche en lipides comme celui des spores (groupe II).

Remarquons encore une fois que dans le groupe I,qui devrait correspondre au genre Pteridomyces, les hyphes sont soit du type "a" (cas de P. galzinii, espèce type mais aussi de P. lacteus sp. nov.), soit de type "b" (P. roseolus sp.nov. et surtout P. sp.n° 8270) ce qui ne cadre plus avec la définition du genre Pteridomyces.

Tous les cas de mitisme se rencontrent dans le groupe II (tabl. 1).

Emergences	Contexte (racines des émergences exclues)	
	monomitique	dimitique
A/ sans hyphes squelettiques	E. typhae E. effibulata E. macarangae	E. interrupta
		sp. 5697
B/ faites surtout d'hyphes squelettiques	S. nikau E. guadelupensis E. malaiensis E. ovalispora	E. citrispora

Tableau I. Champignons épitheloïdes du groupe II (à grandes basides).
On pourrait envisager au moins deux découpages 1) en fonction du contexte (colonnes verticales), 2) en fonction de la présence ou non d'hyphes squelettiques dans les émergences (ligne A: Epithele, ligne B: Skeletohydnum). Sont soulignées les espèces types.

Ces constatations peuvent amener deux types de décisions opposées:
1°- se baser sur la diversité des cas rencontrés pour poursuivre l'éclatement et, par exemple, créer un genre pour les Pteridomyces du type "b", les Skeletohydnum du type "c", ceux du type "e"... Si l'on veut en outre tenir compte des particularités des parois sporiques, des boucles... on peut envisager un plus grand nombre encore de combinaisons donc de genres nouveaux très homogènes mais souvent monospécifiques (mais alors à quoi servent les genres?).
2°- se baser sur cette même diversité pour refuser la multiplication des genres et accepter que les tendances évolutives, toujours en cours, provoquent une certaine diversification, donc une certaine hétérogénéité à l'intérieur des genres conçus plus vastes mais constitués d'espèces que l'on suppose naturellement apparentées.

Nous choisirons la prudence, c'est-à-dire la deuxième solution et ne créerons aucun genre. Le genre Pteridomyces sera ouvert aux espèces à émergences de nature squelettique.

Pour le groupe II, trois alternatives se présentent: définir 4 genres, n'en retenir que deux qui correspondraient soit aux deux colonnes verticales (l'un à contexte monomitique, l'autre à contexte dimitique) soit aux deux lignes horizontales (émergences faites ou non d'hyphes squelettiques): Epithele et Skeletohydnum ; la troisième solution consiste comme pour le groupe à petites basides à ne retenir qu'un seul genre et donc à réduire Skelethohydnum en synonymie d'Epithele.

Ceci revient à reconnaître deux lignées, l'une aux petites basides claviformes et aux spores de moins de 9 µm de longueur, l'autre aux grosses basides et aux spores de plus de 10 µm de longueur, chaque lignée ayant plus ou moins évolué vers le dimitisme. Seule l'étude d'un plus grand nombre d'espèces, récoltées en des points les plus divers du globe terrestre permettra de mieux préciser les ensembles génériques naturels à distinguer.

En attendant, nous décrirons ci-après, dans l'ordre, les espèces

1. du genre Epithele, 2. celles du genre Pteridomyces emend., et enfin 3. le Vesiculomyces épitheloïde.

Pour chaque espèce, dans la mesure du possible nous ajouterons les caractères culturaux qui seront en outre résumés selon le code de Nobles déjà complété par J. Boidin (1966 a, p. 6) et P. Lanquetin (1973 p. 37 note 2).

D'autres additions paraissant utiles, nous regroupons ci-après, avec ces nouvelles propositions l'ensemble des compléments antérieurement publiés.

Les numéros soulignés sont ceux qui sont proposés pour la première fois.

Oxydases
2: laccase et tyrosinase présentes simultanément
2a: laccase seule présente
2b: tyrosinase seule détectée

Boucles
3c: boucles constantes (présentes à toutes les cloisons vraies)
3i: boucles inconstantes (des cloisons simples séparent certains articles nucléés)
3r: boucles rares

Eléments dextrinoïdes
8d: fibres dextrinoïdes (ex: Scytinostroma)
25d: dichophyses dextrinoïdes (ex: Vararia, Dichostereum)
28: asterophyses dextrinoïdes (ex: Asterostroma), P. Lanquetin avait en 1973 proposé pour celles-ci le n°19, préoccupé par Nobles (1967) pour "des cellules terminales moniliformes"

Gloeocystides
15: signifie présence de gloeocystides sans précision sur la réaction du contenu. Nous proposons d'ajouter :
15a : gloeocystides sulfo-aldéhydes positives
15b : gloeocystides sulfo-aldéhydes négatives (Boidin et al.1980)
15p: gloeocystides avec schizopapille(s)

Thallie
59: signifie bipolaire (monofactorielle), 60:tétrapolaire (bifactorielle).
59A: amphithalle bipolaire
60A: amphithalle tétrapolaire (proposé in Boidin et al.1976 p. 258)

Comportements nucléaires au cours du cycle
61: normal: spore uninucléée, mycélium primaire (=myc. I), uninucléé, mycélium secondaire (myc. II) binucléé.
62: subnormal: spore binucléée, myc. I âgé uninucléé, myc. II binucléé.

63: hétérocytique : myc. I à articles terminaux plurinucléés
myc. II binucléés

64: myc. I inconnu, myc. II binucléé

65: astatocénocytique: myc. I multinucléé, myc. II binucléé ou multinucléé selon les conditions d'aération; marge formée d'hyphes axiales multinucléées. (va généralement de pair avec le caractère 4)

66: holocénocytique: myc. I et II multinucléés,

67: holomonocaryotique (Kühner 1977): mycélium (monosperme comme polysperme) uninucléé

68: holodicaryotique (Kühner 1977): spore binucléée germant en un mycélium binucléé.

Clé des champignons épitheloïdes étalés des régions intertropicales

A- Spores amyloïdes réniformes, 7-8,5 x 4,5-5,5 µm; grosses gloeocystides 150-250 x 10-20 µm sulfoaldéhyde-positives. Basidiome saumoné à bordure blanche. Madagascar.
14 *Vesiculomyces epitheloides*

A- Spores non amyloïdes...B

B-Spores petites n'atteignant pas 9 x 5 µm; petites basides claviformes 15-20-(30) x 4-5 µm: *Pteridomyces* emend...........................C

B- Spores et basides plus grandes: *Epithele* emend....................F

C- Spores subsphériques 4,5-5,5 x 3,8-4,8 µm, basidiome blanc grisâtre, émergences faites d'hyphes bouclées à paroi épaissie. Côte d'Ivoire.
13 *P. sphaericosporus*

C- Spores oblongues, ellipsoïdes ou subcylindriques.................D

D- Basidiome blanc de craie, émergences faites d'hyphes à paroi mince. Spores ellipsoïdes 6-8 x 3-4 µm. Gabon.
10 *P. lacteus*

D- Basidiome beige ou beige rosé, émergences faites d'hyphes à paroi épaisse et cyanophile...E

E- Spores subcylindriques 5-6 x 2-2,5 µm;
République Centrafricaine. 11 *P. roseolus*

E- Spores oblongues 3,5-4 x 2,5-2,8 µm;
Singapour. 12 *P. sp.* 8270

F- Emergences faites uniquement d'hyphes à paroi mince...............G

F- Emergences faites d'hyphes de type squelettique, raides, serrées en faisceau, parfois recouvertes d'un manchon d'hyphes bouclées...I

G- Pas de boucles; spores fusiformes, 17-21 x 7-10 µm, sur Palmae; Gabon, Sierra Leone (?) 2 *E. efibulata*

G- Boucles; spores ellipsoïdes, 14-20 x 6,5-8,2 µm, émergences obtuses fragiles; République Centrafricaine...............................H

H- Contexte monomitique sans fibres. 5 *E. macarangae*

H- Contexte nettement dimitique, Zaïre. 4 *E. interrupta* Bres.

I- Spores nettement biapiculées, 14-18 x 7-8 µm; contexte dimitique; Côte d'Ivoire, Gabon. 1 *E. citrispora*

I- Spores ellipsoïdes, oblongues ou ovoïdes...........................J

J- Spores larges de plus de 8 µm......................................K

J- Spores ellipsoïdes ne dépassant pas 6 µm de largeur..............L

K- Spores oblongues subelliptiques 17-21 x 8-10 µm; sur *Palmae*; Singapour. 6 *E. malaiensis*

K- Spores ovoïdes, 13,5-17,5 x 8,5-11 µm; sur *Palmae*;
   Gabon. 8 *E. ovalispora*
L- Contexte épais, lâche, riche en fibres; champignon détachable. Spores
   ellipsoïdes 10-12 x 5-6,5µm; Argentine. 9 *E. sp. 5697*
L- Contexte mince et dense; champignon très adhérent...........M
M- Spores 10-14 x 4,5-6 µm; Gabon. 7 *E. nikau* Cunn.
M- Spores 14-18 x 4,5-5,8 µm; Guadeloupe 3 *E. guadelupensis*

I - Genre *Epithele* (Pat.) Pat. 1900.
Synonyme: *Skeletohydnum* Jülich 1979

Nous plaçons ici les espèces à grosses basides et grandes spores blanches ou crèmes, à paroi mince ou un peu épaissie, lisses et qui ne sont ni amyloïdes, ni dextrinoïdes, ni cyanophiles. Les hyphes génératrices sont avec ou sans boucles. Les hyphes squelettiques sont absentes ou présentes dans le contexte, dans le contexte et les émergences, ou dans les émergences seules.

1- *Epithele citrispora* Boidin, Lanquetin et Gilles, sp. nov.
Fig. 1

Jacens, solida, adhaerens, alba vel cremea, emergentiis concoloribus, regulariter dispositis hirta, 40-50 µm crassa. Trama hyphis skeleticis permultis (praeter in parte infima). Emergentiis 75-170 x 30-80 µm transgredientibus, ex hyphis skeleticis verticalibus, tunica crassissima, praeter in superiore parte, quae speciem dendroideam accipere possunt, constantibus. Basidiis 35-50 x 9-12 µm, fibulatis. Sporis biapiculatis, 14-18 x 7-8 µm, haud amyloideis neque cyanophilis, guttulis oleaginosis completis. In ligno. Holotypus LY 8537. Gabon.

A la récolte, largement étalé, solide, adhérent, blanc un peu grisâtre (Munsell 2,5 Y 8/1 à 10 YR 8/1), tout couvert de petites aspérités concolores; marge similaire assez brusque, parfois pruineuse.

En herbier, étalé gris clair quand il est très mince (5 Y 8,5/2) à crème (5 Y 8,5/3,5) ou crème sale (2,5 Y 8,5/4), adhérent à marge brusque ou au contraire progressivement amincie et plus blanche; sous la loupe il est tout hérissé d'émergences concolores assez régulièrement disposées.

Epais de 40-100-250 µm, il est formé d'une couche inférieure dans laquelle prennent naissance les émergences entre lesquelles s'établit une couche supérieure hyméniale bien différente. La couche inférieure haute de 15-160 µm peut montrer contre le support quelques hyphes génératrices bouclées à paroi un peu épaissie, collées entre elles en une sous-couche horizontale dense de 5-15 µm d'épaisseur; très vite s'y mêlent des hyphes squelettiques larges de 2-2,8 µm non cyanophiles, à lumen subnul, les plus profondes horizontales, mais vite entrecroisées et emmêlées en tous sens, parfois ramifiées, qui forment l'essentiel de la couche inférieure; les hyphes génératrices à paroi mince ou peu épaissie, x 1,5-1,8-(3) µm semblent très rares.

Emergences subcylindriques ou un peu côniques mais obtuses, ancrées à la base du basidiome et dépassant l'hyménium de 75-170 x 30-50-80 µm; elles sont formées d'hyphes de type squelettique dressées parallèlement en faisceau; elles sont larges de 2,5-(3,8) µm, leur paroi très épaisse s'amincit à l'extrémité qui peut se ramifier et prendre un aspect dendroïde; pas ou peu de cristaux dans les émergences.

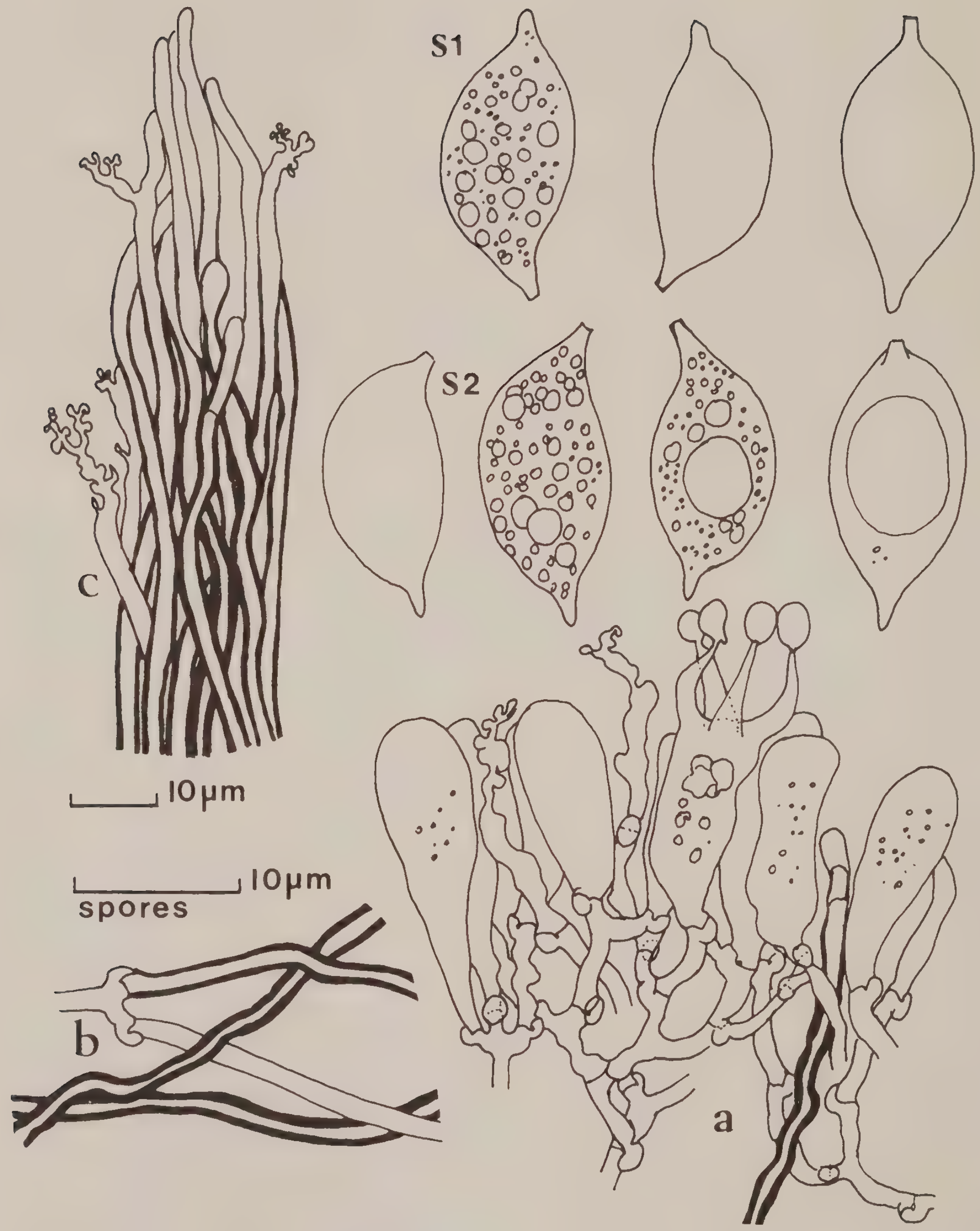

Figure 1: Epithele citrispora sp.nov. : a- hyménium, et s1,spores (holotype LY 8537); b- contexte, et c- sommet d'une émergence (LY 7158); s2- spores (LY 9013).

Les échelles sont valables pour les figures 1 à 8.

Hyménium formé de basides trapues, 35-50 x 9-10-12 µm, brusquement rétrécies à la base qui est bouclée, à 4 forts stérigmates 7-14 x 3 µm; leur contenu est guttulé gras; elles sont portées par des hyphes sous-hyméniales bouclées très ramifiées qui peuvent émettre des hyphes dendroïdes à paroi mince, souvent peu remarquables, qui atteignent la surface; dans le sous-hyménium peuvent s'engager des hyphes squelettiques verticales issues de la couche inférieure, qui montent plus ou moins haut et peuvent émerger isolément ou en groupes.

Spores citriformes biapiculées, 14-18 x 7-8-(9) µm, non amyloïdes ni cyanophiles au contenu multiguttulé. Pour le type, $\bar{x}$ = 15,17 ± 1,0 $\bar{x}$·7,14 ± 0,35, pour 9013, $\bar{x}$ = 16,06 ± 1,11 x 7,95 ± 0,41.

C'est la seule récolte africaine qui réponde tout à fait à la diagnose du genre *Skeletohydnum* Jülich. Elle ne peut cependant pas être séparée génériquement d'*E. ovalispora*, *fusispora*, *malaiensis*...etc.

Récoltes: COTE D'IVOIRE: LY 7158, forêt du Téké près d'Abidjan, 29 avril 1973 G. Gilles 210.
GABON: LY 7843, sur branchette, île aux chauves-souris, Makokou, 13 mai 1976 (*): LY 8537, HOLOTYPE, sur bois dans le fourré littoral, N. de Libreville, 21 janvier 1978, G. Gilles 1070; LY 9013, en forêt ombrophile, ibid., 3 décembre 1978, G. Gilles 1320; LY 9106, fourré littoral, 6 janvier 1979; LY 9142, forêt ombrophile, 27 janvier 1979 et LY 9199, ibid., 17 février 1979, tous trois leg. G. Gilles sans n°.

Caractères culturaux d'*E. citrispora*

SPORES.- (LY 7158-8537-9013-9106) uninucléées, mais pour un grand nombre de spores, le contenu reste très hétérogène et il est impossible de préciser.

GERMINATIONS.- Elles n'ont pas été obtenues malgré plusieurs essais avec LY 7158, 7843, 9013 et 9106.

POLYSPERME.- Seul LY 7158 s'est développé.

Croissance: très rapide (boîtes couvertes en deux semaines)

Aspect: La marge est régulière. Le mycélium présente un aspect fidèle dans toutes les boîtes: la surface de la culture est uniformément lisse, blanc pur, mate à jour frisant. Ce disque blanc est souligné, à la périphérie contre le verre, par une fine ligne presque continue brun sombre (vers5 YR 3/3 chocolat)) et il peut aussi très localement montrer de minuscules points brunâtres (5 YR 4/6 et 3/3). Dans l'une des boîtes le mycélium teinté forme une petite plage (fawn R., 5 YR 5,5/4). Après trois mois une autre boîte montrait plusieurs petites plages brunes et des zones densément piquetées de petits points bruns.

Revers des cultures: inchangé. Odeur nulle.

Microscopie:

Mycélium aérien: il forme une peau détachable à la pince mais assez cassante. Cette peau est constituée surtout d'hyphes régulières, x 1,2-2 µm, à paroi mince, bouclées, densément emmêlées avec des hyphes plus larges x3-4 µm, du côté de la gélose. Vers la bouture, quelques hyphes superficielles portent des cristaux réfringents pouvant former une gaine. Dans les petits points bruns, les hyphes, irrégulières, ont une paroi nettement brunie qui s'épaissit aux extrémités.

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* :quand le récolteur est J.Boidin,il n'est pas indiqué.

Mycélium submergé: hyphes à paroi mince, bouclées, x 2-8 µm, riches en gouttes réfringentes, les étroites bien cylindriques et les élargies plutôt irrégulières avec boucles surbaissées. Quelques hyphes régulières, x (2,5)-4-7 µm, ont une paroi nettement épaissie, x 0,5-1 µm, prenant mal le rouge Congo, elles sont bouclées et montrent aussi de nombreuses cloisons de retrait bombées.

Boucles: constantes.

Cytologie: Hyphes aux articles régulièrement binucléés, bouclés.

Oxydases: ac. gallique: +++++,0 gaïacol: ++++,0
p.-crésol: -, précipité blanc tyrosine: -, 10 mm

CODE: 2a - 3c - 32 - 36 - 38 - 42 - 54 - 64

Remarque. A part la formation d'un fin liseret brun autour des cultures très blanches, et la forme spéciale des boucles sur les hyphes submergées, le mycélium de cette espèce est très peu caractéristique.

2. Epithele efibulata Boidin, Lanquetin et Gilles sp. nov.

Fig. 2

Parvis maculis formata, deinde membranacea, alba vel cremea, emergentiis gracilibus, concoloribus praedita. Trama monomitica, sine fibulis. Emergentiis ex hyphis horizontalibus cohaerentibus, tunica tenui vel parum incrassata constantibus. Basidiis 32-52 x 8-10 µm. Sporis ellipsoideis, 17-21 x 7-10 µm, tunica paulum incrassata ac aetate luteola, haud cyanophila neque amyloidea. In Palmaceis. Holotypus LY 7863. Gabon.

A la récolte, il se présente en petite taches distinctes puis confluentes; il est membraneux, détachable sous l'aiguille, blanc puis crème (2,5 Y 8/2 à 8,5/4), crème alutacé (10 YR 8/3 et même 8/4) avec marge lisse, blanc grisâtre (2,5 Y 8/2 ou 10 YR 8/1,5); sous la loupe il est couvert d'émergences grêles, concolores.

En herbier, il apparaît mince, adhérent, fragile (pulvérulent sous le rasoir), parfois fendillé, alutacé pâle (10 YR 9/3,5 9/4) à crème (2,5 Y 8/4) avec marge amincie plus pâle et sans émergences.

Epais de 100-200 µm hors des émergences qui débordent de 70-180 x 25-35-(50) µm. Couche basale, haute de 15-50 µm, d'hyphes horizontales serrées, x 2-3 µm, à paroi mince et cloisons simples, puis hyphes obliques redressées formant une zone transitoire plus lâche: ces hyphes, x 2-2,5 µm à paroi mince, sont fréquemment ramifiées et peuvent contenir des gouttelettes lipidiques; dans cette zone se déposent parfois d'abondants amas cristallins.

Emergences constituées d'hyphes parallèles, cohérentes, à paroi mince ou peu épaissie, sans boucles; à leur surface on peut voir des extrémités dendroïdes; dans la partie profonde de ces émergences on peut trouver de rares hyphes à paroi plus épaissie et des dépôts engainants de cristaux détersiles.

Zone hyméniale dense, formée d'hyphes grêles, x 2 µm, et de basidioles claviformes riches en huile entre lesquelles peuvent émerger des hyphes dendroïdes (visibles surtout dans le bleu lactique) dans lequel on voit en outre des dépôts de fins cristaux bacillaires sur les éléments superficiels. Basides 32-52 x 8-10-(11) µm au sommet mais plus large à mi-hauteur (par ex. 13 µm) portant 4 gros stérigmates longs de 9-13 µm; elles peuvent émerger de 12-20 µm au-dessus des basidioles.

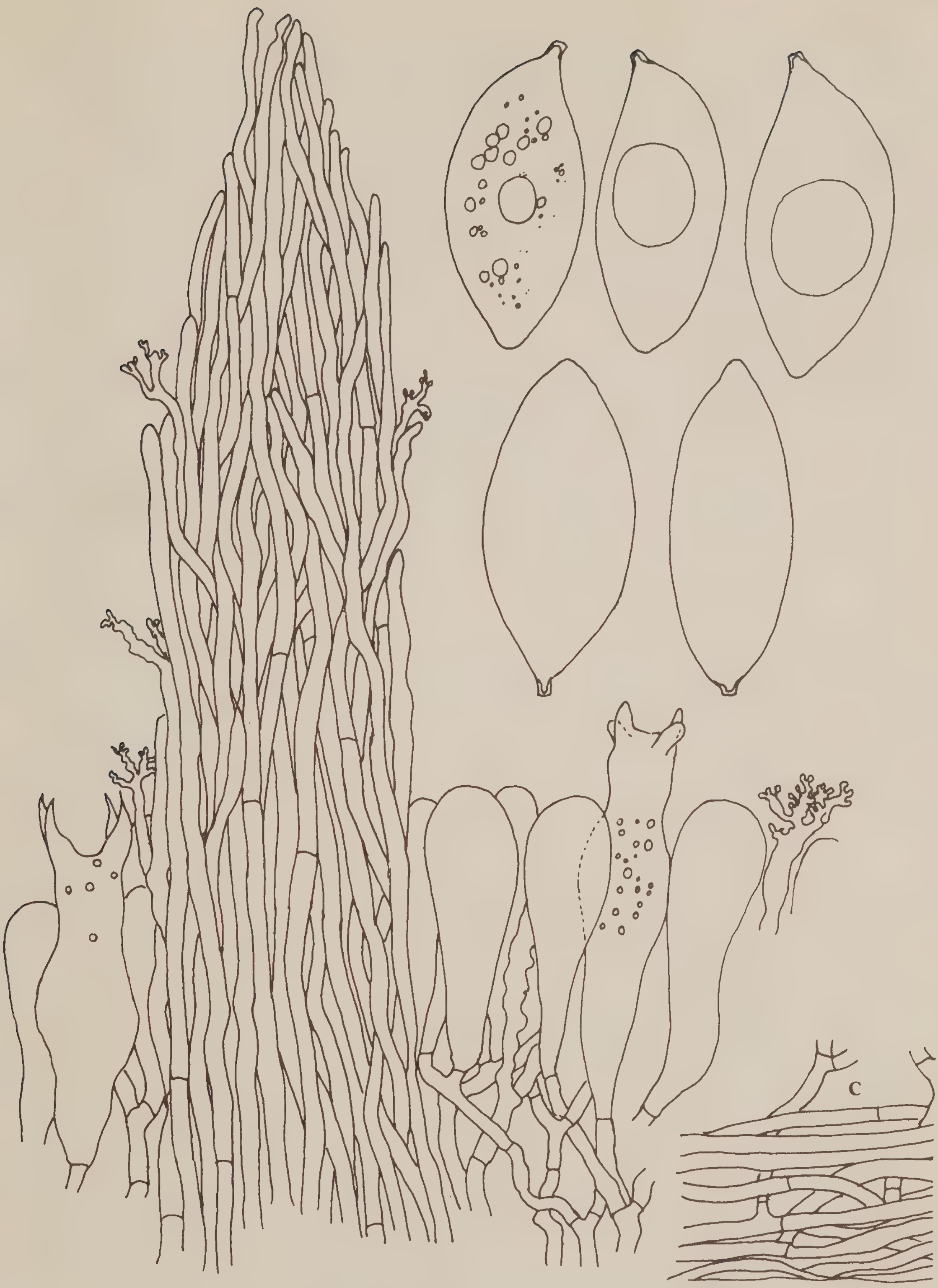

Figure 2: Epithele efibulata sp.nov.: coupe du basidiome (KOH-Phloxine), c- couche basale; s- spores (sporée LY 9155).

Spores fusiformes (14)-17-21-(23) x (6)-7-10-(11) µm, à sommet parfois un peu pincé (tendance biapiculée), au contenu gras, à paroi faiblement épaissie (moins de 0,5 µm). Cette paroi n'est ni amyloïde , ni cyanophile. Sur les exsiccata quelques spores semblent avoir une paroi épaissie mais c'est une impression due à la rétraction et au décollement du cytoplasme; ces spores âgées peuvent apparaître jaunâtres et flétries, elles ont une section polygonale.

Les mesures statistiques sur sporées vont de 17,23 x 7,26 pour 9146 à 20,57 x 9,28 pour 9155 mais il s'agit dans ce dernier cas d'un basidiome largement étalé, alors que 9146, jeune encore, est formé de petites taches disjointes.

Récoltes: GABON: LY 7863, HOLOTYPE, sur *Raphia* sp., marigot à Makokou, 17 mai 1976; LY 7867 ibid.; LY 9120, sur *Eremospatha macrocarpa*, La Mondah, 21 janvier 1979, G. Gilles 1407; LY 9145 et 9146, sur *Elaeis guineensis*, La Mondah, 3 février 1979, G. Gilles 1425 et 1426; LY 9155 sur *Raphia* sp., 10 février 1979, G. Gilles 1436; LY 9167 et 9168, sur *Elaeis guineensis*, 18 février 1979, G. Gilles 1447 et 1448; LY 9182, ibid. 24 février 1979, G. Gilles 1459; LY 9206 ibid., 10 mars 1979, G. Gilles 1479; LY 9277, ibid., 14 avril 1979, G. Gilles sans n°.

C'est la seule espèce d'*Epithele* qui soit dépourvue de boucles. Nous avions pensé, à la lecture de Boquiren que cette espèce pourrait être *Epithele interrupta* Bres. Il faut abandonner ce point de vue après étude du type (in BR) qui vient du Zaïre (Mayidi, 1er février 1910 leg. Vanderyst). Il s'agit d'une récolte avec émergences dispersées, peu nombreuses, courtes, obtuses, fragiles, faites d'hyphes bouclées à terminaisons dendroïdes, mais dimitique par des fibres hyalines nombreuses dans le contexte. Boquiren avait étudié une récolte de Sierra Leone déterminée *E. interrupta* (in DAOM 99.845, sur *Elaeis guineensis*) qui ne peut être l'espèce de Bresadola; bien que Boquiren ne précise ni la présence ou l'absence de boucles, ni celles d'hyphes squelettiques, certaines de ses données et figures laissent à penser qu'il pourrait s'agir d'*E. efibulata.*

Caractères culturaux d'*E. efibulata*

SPORES.- (LY 7863, 7867) uninucléées.
GERMINATIONS.- non obtenues
POLYSPERME.- (LY 7863, 7867, 9120)
Croissance: très rapide (boîtes couvertes en deux semaines)
Aspect: la marge est très régulière. Le mycélium aérien blanc pur forme une peau feutrée, appliquée, lisse, mate, pouvant toutefois montrer un ou deux plis. A la périphérie des cultures 9120, il apparaît grumeleux-floconneux et se teinte localement de crème 10 YR 9/2. A la périphérie de 7867, il se forme de petites masses de 1 à 8 millimètres de diamètre hérissées d'aiguillons un peu jaunâtres, et exsudant des gouttelettes hyalines à ambre clair.
N.B. Les cultures LY 9120 révèlent par transparence des plages un peu rosâtres, pratiquement non discernables dans les boîtes observées par dessus ou par dessous.

Le revers des cultures est inchangé, l'odeur nulle.

Microscopie:

Mycélium aérien: il est constitué d'hyphes régulières, x 1,5-2-(3) µm, à paroi mince, sans boucles. Beaucoup d'hyphes sont affaissées. La peau feutrée prélevée dans la partie âgée, est formée d'éléments solidement agglomérés, très difficiles à séparer par écrasement; il s'agit d'hyphes, x 2-3-(5) µm, sinueuses, contournées, ramifiées, emmêlées, à paroi hyaline épaisse à très épaisse, (1,2-1,5 µm par ex.) formant un puzzle dense. Les plages légèrement colorées vues par transparence sous le mycélium superficiel blanc de LY 9120, correspondent à une croûte coriace pareillement constituée en puzzle. Les émergences observées seulement dans LY 7867 sont formées d'un faisceau d'hyphes parallèles, x 1,5-2-(2,5) µm, régulières à paroi mince, sans boucles. Toutefois quelques rares hyphes ont une paroi nettement épaisse. Certaines hyphes à paroi mince, sans boucles, se ramifient vers leur extrémité mais la présence de petits cristaux gêne l'observation. Il faut utiliser le mélange KoH-Phloxine pour bien voir ces courtes ramifications à aspect de fines dendrophyses.

Mycélium submergé: Après avoit ôté la peau blanche du mycélium aérien, on peut observer de rares lignes blanches sillonnant le milieu gélosé. Une telle ligne bien visible sur une coupe transversale apparaît faite d'hyphes x 2-3 µm, à paroi épaisse très intriquée en puzzle.

Ailleurs le mycélium submergé est formé d'hyphes x 4-6 µm, assez régulières, à cloisons simples, et de rameaux, x 1,5-2 µm, assez ramifiés. Quelques hyphes, x 3-4 µm, ont une paroi épaissie à nettement épaisse, x 0,8-1 µm, ce ne sont pas des fibres.

Boucles: absentes

Cytologie: les trois polyspermes sont formés d'hyphes aux articles régulièrement uninucléés. Le croisement des deux polyspermes 7863 et 7867 a donné un mycélium aux articles également uninucléés. L'espèce pourrait être parthénogénétique.

Oxydases: ac. gallique +++++,0 gaïacol: +++++, 0
p.-crésol: -, précipité blanc tyrosine: -, 0 à 20 mm

CODE: 2a - 6 - 11 - 32 - 36 - 38 - 42 - 54 - 67

Remarque. Cette culture est faiblement caractérisée par sa croissance rapide, la présence d'hyphes agglomérées en puzzle et par ses cultures polyspermes sans boucles aux articles uninucléés. Cette espèce holomonocaryotique est vraisemblablement parthénogénétique haploïde ce qui explique l'absence de boucles. De telles espèces ne peuvent être séparées généralement des espèces parentes binucléées. C'est le cas par exemple d'*Hypodontia efibulata* Erikss. et Hjortst., (Hassan et David, inédit), d'un *Podoscypha* centrafricain sans boucles (inédit) de *Vararia aurantiaca* Boid. et Lanq. (Boidin et al 1980).

3. *Epithele guadelupensis* Boidin et Lanquetin sp. nov.

Fig. 3 A

Jacens, tenuis, fragilis, ex alba griseola, in margine levi pallidior, 30-50 µm crassa, emergentiis albis, regulariter dispersis, 75-130 x 15-20 µm, crassamentis crystallinis vestitis, ex hyphis rigidis, refringentibus, tunica incrassata. Hyphis genetricibus fibulatis, stratum densum pseudoparenchymaticum formantibus, deinde in perpendiculum directis. Basidiis 22-35 x 6-7,5 µm, 4 sterigmatis divergentibus; adsunt nonnullae hyphae dendroideae inter basidiola et in emergentiis. Sporis ellipsoideis, 14-18 x 4,5-5,8 µm, haud amyloideis neque cyanophilis. In Palmaceis. Holotypus LY 8119. Guadeloupe.

A la récolte, étendu, mince, blanc grisâtre (neutral 8/0) avec marge atténuée pruineuse sous la loupe, lisse sur un demi mm puis à petites émergences blanches régulièrement disséminées.

En herbier, étalé, adhérent, blanc grisâtre (neutral 8/0) puis crème, atteignant (5 Y 8/3,5) avec marge amincie plus blanche; les émergences apparaissent très tôt près de la bordure et s'allongent ensuite, elles sont nombreuses, serrées. Sous le rasoir le champignon est fragile et cassant.

En coupe, très mince 30-50 µm environ avec émergences élancées, côniques, 75-100-130 x 15-20 µm, recouvertes de dépôts cristallisés, prenant naissance à la base du basidiome. Sur quelques hyphes génératrices bouclées à paroi mince, formant une mince couche d'aspect paranchymateux en coupe transversale, se dressent les éléments du sous-hyménium et de l'hyménium.

Emergences formées d'hyphes raides réfringentes x 1,8-2,2 µm, à paroi épaissie sauf vers l'extrémité effilée, assez congophile après traitement ammoniacal à 60°; elles portent souvent en surface des hyphes à paroi mince qui peuvent se redresser et montrer des terminaisons dendroïdes; à leur base les hyphes à paroi épaissie sont sinueuses parfois ramifiées.

Basides trapues, souvent un peu étranglées, 22-35 x 6-7,5 à 4 stérigmates de 7-8 x 2 µm, écartés. Des hyphes dendroïdes émergent entre les basidioles au contenu guttulé.

Spores ellipsoïdes de face, 14-18-(20) x 4,5-5,8 µm, ($\bar{x}$ = 15,97 ± 1,20 x 5,18 ± 0,32), au contenu gras, à paroi mince non amyloïde ni cyanophile; l'apicule est réfringent.

Récoltes: GUADELOUPE: LY 8119, HOLOTYPE, sur rachis de *Prestoa montana* (*Palmae*) au sol, Bras David, 4 octobre 1976.

Caractères culturaux d'*E. guadelupensis*

SPORES.- (LY 8119) uninucléées.

GERMINATIONS.- elles sont prélevées deux jours après la dispersion

MONOSPERMES.- A trois semaines, sur 22 prélèvements, 13 sont bouclés, 3 montrent localement des crochets et 3 sont à cloisons simples. La coloration cytologique de ces derniers a donné pour deux d'entre eux des plages totalement binucléées et des plages aux articles régulièrement uninucléés. Le troisième, moins développé, s'est révélé constitué d'articles très régulièrement uninucléés sans boucles, un mois plus tard, cette même culture était formée d'hyphes aux articles régulièrement binucléés bouclés. L'espèce est donc homothalle.

POLYSPERME.-

Croissance: très rapide (boîtes couvertes en deux semaines)

Aspect: marge régulière. Mycélium aérien blanc pur d'aspect typique, faisant penser à une surface farineuse laquelle aurait été balayée presque totalement à certains endroits. Il est plus dense dans la zone jeune où de nombreuses fibrilles entrecroisées forment un réticule peu mis en évidence car rigoureusement blanc sur fond blanc. A la périphérie, les fibrilles, très fines, grimpent contre le verre et vont, en s'étalant décorer la face inférieure des couvercles.

Dans une boîte, nous avons observé de très petites plages crayeuses, de 1,5-2 millimètres de diamètre, ce sont des fructifications qui donnent une sporée crème sale dans le couvercle. Le revers des boîtes est inchangé, l'odeur nulle.

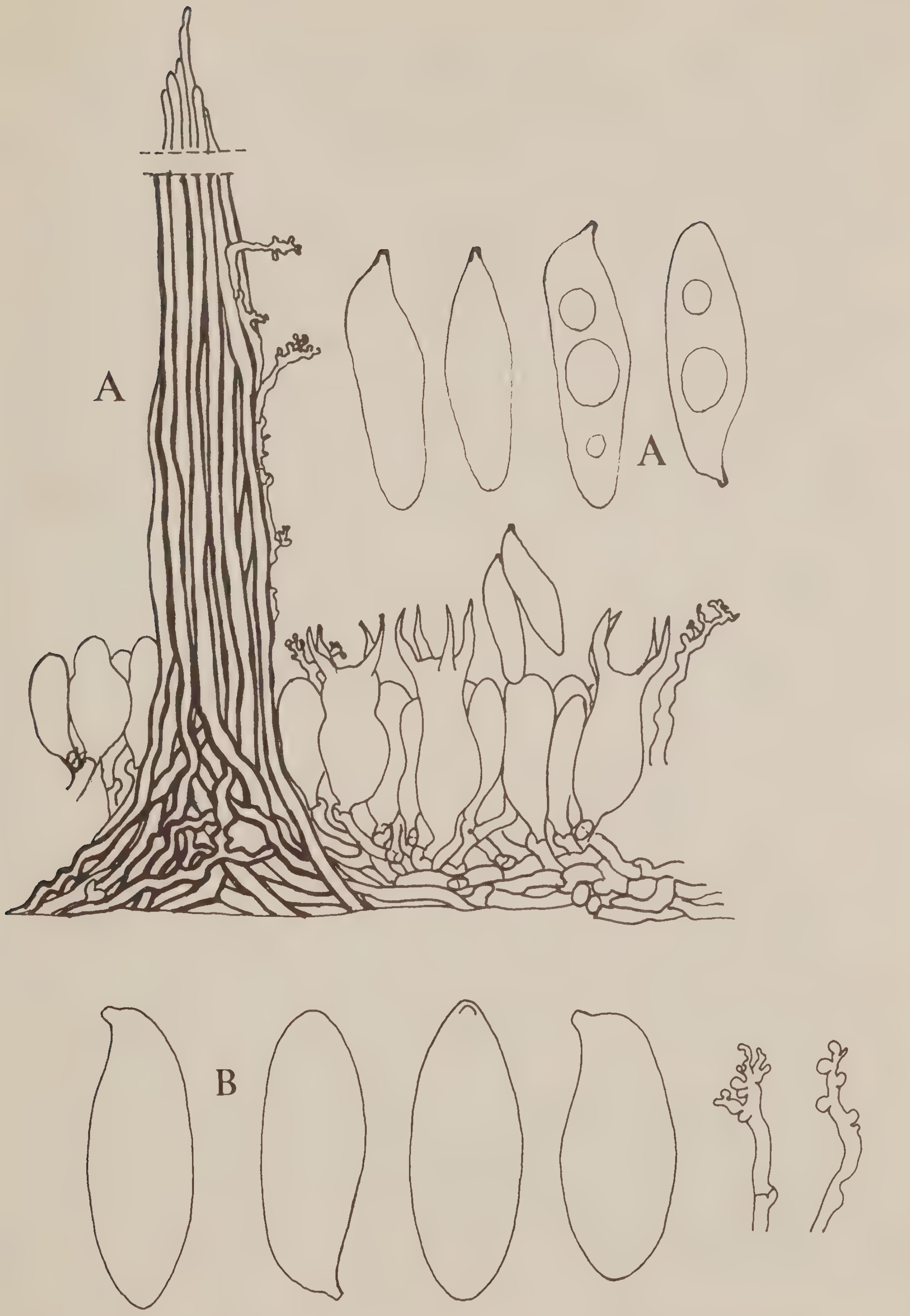

Figure 3: A- *Epithele guadelupensis* sp.nov. (holotype LY 8119).

B- *Epithele interrupta* Bres.: spores vues sur le type, et deux hyphes dendroïdes.

Microscopie:

Mycélium aérien: il est constitué par des hyphes régulières étroites, x 1,2-1,75 µm, à paroi mince, boucles constantes, (en fait beaucoup sont des hyphes collapsées) et quelques hyphes plus larges, x 4-5 µm, régulières bouclées à paroi mince et contenu homogène.

Fructifications:elles montrent de nombreuses émergences pointues de 100 à 140 µm de haut, de nombreuses basides 27-35 x 6,5-7 µm au sommet, bouclés à leur base étroite, x 2 µm, et portant sur 4 stérigmates longs jusqu'à 8 µm, des spores allongées 15 x 5 µm.

Mycélium submergé: Dans le milieu, juste vers la surface, hyphes x 2,5-4 µm, bouclés, à paroi mince, très irrégulières avec multiples bosses ou courtes excroissances; des rameaux très grêles, x 1-2 µm, sont aussi très irréguliers. Quelques axes, x 3,5-5 µm, sont réguliers, à paroi épaissie, congophile (ex. 0,5 µ sur hyphes de 4 µ, 1 µ sur hyphe de 5 µ), et portent des boucles en tibia.

Quelques rameaux bouclés très tortueux comme s'ils allaient s'imbriquer en puzzle mais sans y parvenir, ont une paroi ferme, très réfringente, qui ne prend pas le Rouge congo.

Boucles: constantes

Cytologie: hyphes aux articles binucléés, bouclés

Oxydases: ac. gallique: +++++, tr. gaïacol: ++++, 0
p.- crésol: -, léger précipité blanc tyrosine: -, tr.

CODE: 2a - 3c - 32 - 36 - 38 -42 - (48) - 54 - 57 - 61

Remarque. Culture peu caractérisée, sinon par son aspect (mais nous n'avons qu'une souche!) et son comportement homothalle lent similaire à celui d'*E. nikau*.

4 - *Epithele interrupta* Bres. ap. de Wildeman
Bull. Jard. Bot. Etat (Bruxelles) 4: 25, 1914
non *E. interrupta* sensu Boquiren 1971

Fig. 3 B

En herbier, étalé, mince, membranuleux fragile, crème, à marge amincie blanchâtre. Emergences peu nombreuses, courtes, irrégulièrement disséminées, détachables et laissant une cicatrice circulaire.

Epais de 90-150-250 µm avec hyphes basales distinctes, assez horizontales, régulières, x 2-3,5 µm, bouclées, à paroi mince; s'y ajoutent bientôt de nombreuses fibres hyalines x 1,5-3 µm à paroi très épaissie, s'arrêtant à la base de l'hyménium. Le contexte peut accumuler des amas de cristaux. Hyménium fait de basidioles (environ 60 x 11 µm) au contenu gras passant à des basides larges de 11-13 µm à 4 gros stérigmates; des hyphes dendrophysoïdes parfois nombreuses.

Les émergences, 200 x 150 µm, sont entièrement constituées d'hyphes bouclées à paroi mince ou presque, x 2-4 µm, parfois terminées de manière dendroïde; dépôts abondants de cristaux.

Spores fusiformes, 18-21 x 7-9-(10) µm, au contenu gras, à paroi non cyanophile ni amyloïde.

Récolte examinée: ZAIRE: Mayidi, leg. H. Vanderyst, 1er février 1910,
HOLOTYPE, (in BR).

Nous n'avons pas retrouvé cette espèce en Afrique. Elle est proche d'E. macarangae qui diffère surtout par l'absence d'hyphes squelettiques. L'E. interrupta sensu Boquiren est peut-être E. efibulata (voir à cette espèce).

5. Epithele macarangae Boidin et Lanquetin sp. nov.
Fig. 4 C

Jacens, membranacea, ex alba luteola, e parvis tuberculis, sparsis, brevibus, concoloribus, faciliter caducis, cicatrices orbiculares reliquentibus, constans. Super stratum hypharum horizontalium, x 2,5- 3 µm, fibulatarum, tunica tenui vel incrassata, adsunt hyphae subhymeniales ad perpendiculum erectae, distinctae. Emergentiis 50 x 50 µm, ex hyphis tunica tenui, superne saepe dendroideis, constantibus. Basidiis 30-45 x 10-12 µm, inferne subito angustatis, 4 grandibus sterigmatis. Sporis ellipsoideis, 14-18 x 6,5-8,2 µm, tunica tenui, haud amyloidea neque cyanophila, adipibus abundantibus. In ligno demortuo. Holotypus LY 5395. Centrafrique.

A la récolte, étalé, poruleux puis continu, membraneux, détachable par fragments, blanc un peu jaunâtre (5 Y 9/3 à 8/4), avec marge nulle ou fibrilleuse; émergences éparses, courtes.

En herbier, membranuleux mince, densément fendillé, crème (2,5 Y 8,5/4), orné de petits tubercules peu serrés, courts, concolores; fragiles et facilement caduques, ils laissent une cicatrice circulaire.

En coupe, épais de 75-100 µm; il est formé d'une couche d'hyphes horizontales x 2,5-3 µm, bouclées, à paroi mince à un peu épaissie prenant avec l'âge l'aspect d'une couche très dense aux hyphes moins distinctes à paroi souvent épaissie (la paroi peut atteindre 0,8 µm), mais ramifiées et bouclées. Cette couche basale est haute de 20-50 µm. Au-dessus se redressent les hyphes sous-hyméniales distinctes, x2-3 µm, bouclées à paroi submince portant de grosses basidioles serrées, trapues, largement claviformes puis subcylindriques parfois un peu étranglées, entre lesquelles émergent de nombreuses hyphes dendroïdes à stipe x 2 µm, à paroi mince.

Basides 30-45 x 10-12 µm au sommet, à 4 forts stérigmates longs de 10-12 µm; leur base bouclée est très fortement rétrécie, parfois avec un court stipe hyphifrome (podobaside).

Les émergences caduques, sont généralement absentes des coupes; larges de 50 µm, elles émergent aussi d'environ 50 µm et sont formées d'hyphes à paroi mince x 3-3,5 µm, souvent terminées en dendrophyses complexes; elles peuvent porter des dépôts cristallins.

Spores un peu crème en masse, ellipsoïdes de face, ellipsoïdes à subcylindriques de profil et un peu déprimées sous l'apicule, 14-18-(20) x 6,5-8,2 µm ($\bar{x}$ = 16,68 ± 1,50 x 7,42 ± 0,42 pour le type); leur paroi est mince, non amyloïde, ni cyanophile, leur contenu riche en graisses.

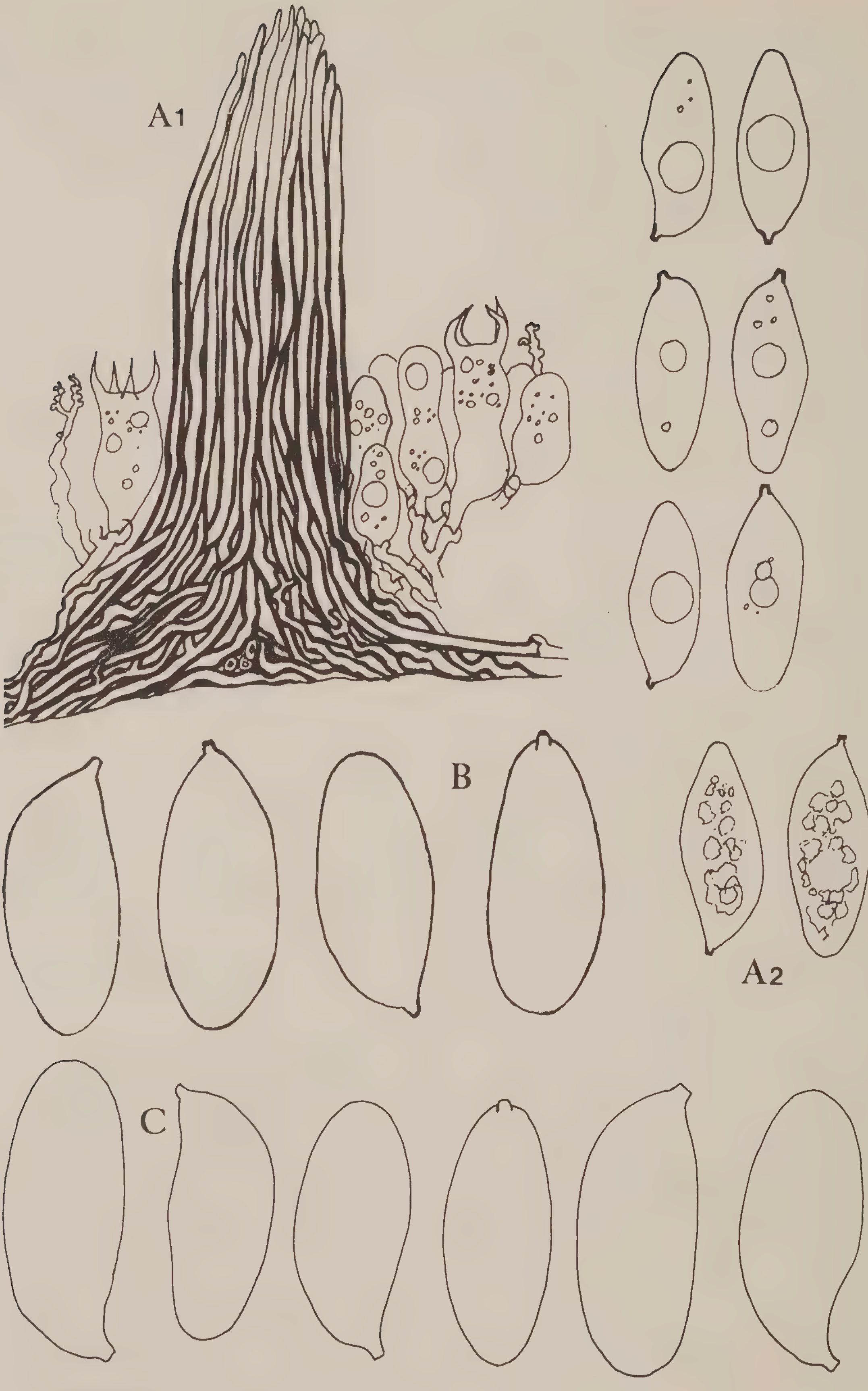

Figure 4.

Récoltes: REPUBLIQUE CENTRAFRICAINE: LY 5395, HOLOTYPE, sur branchettes mortes, forêt touchant la savane de Bébé près Boukoko, 11 mai 1945; LY 5410, sur Macaranga spinosa (Euphorbiacée), La Maboké, 12 mai 1965; LY 5478, sur branchette suspendue, Boukoko, 18 mai 1965.

Cette espèce est facile à reconnaître de la plupart des Epithele décrits ici à ses émergences éparses, obtuses, fragiles et même caduques laissant une cicatrice circulaire, et l'on pourrait hésiter à la placer dans le genre Epithele; Toutefois ses basides et dendrophyses sont du type habituel dans ce genre. Elle est proche d'E. interrupta Bres. par ses émergences et ses spores, mais ne montre aucune hyphe squelettique dans son contexte.

Caractères culturaux d'E. macarangae

SPORES.- uninucléées (LY 5395).

Douze jours après la dispersion des spores, de très rares germinations sont apparues. Observées un mois plus tard les 3 germinations isolées sont formées d'hyphes à cloisons simples, alors qu'à cette même date la culture polysperme montrait des hyphes étroites, régulières, x 1,5-3 µ, à boucles constantes. L'espèce est donc présumé hétérothalle.

Malheureusement stockées à 4°C, ces cultures ont péri avant d'avoir pu être étudiées plus complétement.

6. Epithele malaiensis Boidin et Lanquetin sp. nov.

Fig. 4 B

Tenuibus maculis, bene limitatis, maxime adhaerentibus, ex albis griseis vel pallide alutaceis formata, 30-40 µm crassa inter emergentias conicas, 200-250 x 35-40 µm, quae ex hyphis skeleticis rigidis constant. Hyphis genetricibus fibulatis; inter basidia 30-45 µm longas, tetrasporas, adsunt nonnullae hyphae dendroideae. Sporis oblongis e facie visis, 17-21 x 8-10 µm, tunica paulum incrassata, haud amyloideis neque cyanophilis. In Palmaceis. Holotypus: LY 8252, Singapour.

A la récolte, en tâches bien délimitées, minces, très adhérentes, blanc grisâtre (10 YR 8/1) atteignant gris alutacé pâle (10 YR 8/2,5) au centre, à marge brusquement amincie; il est couvert dès la marge d'émergences concolores, régulières.

Figure 4: A- Epithele nikau Cunn.: 1- coupe du basidiome au niveau d'une émergence, et spores (LY 9119), in NH4OH 60°C-Congo; 2- spores de l'holotype (in K).
B- Epithele malaiensis sp. nov.: spores de l'holotype (LY 8252).
C- Epithele macarangae sp. nov.: spores de l'holotype (LY 5395).

En herbier, très adhérent, blanc à alutacé pâle (10 YR 8/3 à 8,5/4).

En coupe, il apparaît très mince (30-40 µm) entre les émergences côniques de longueur totale de 200-250 µm, larges de 35-40 µm à la sortie de l'hyménium, plus larges à l'enracinement qui se fait sur le substratum.

Emergences constituées d'hyphes squelettiques rigides, x 1,8-2,5 µm sensiblement congophiles après traitement ammoniacal à 60°C qui dissout un dépôt plus ou moins cristallisé qui les englue; à l'écrasement quelques hyphes dendroïdes s'en détachent et l'on voit à la base que les fibres sont un peu plus larges à paroi plus épaissie et sont sinueuses. Entre les émergences quelques hyphes génératrices peu distinctes, bouclées, portent des hyphes sous-hyméniales à paroi submince; hyménium formé de grosses basidioles ovoïdes puis claviformes à subcylindriques, riches en gouttelettes réfringentes, et d'hyphes dendroïdes grêles; basides fortes, longues de 30-45 µm brusquement rétrécies à la base qui est bouclée, portant 4 gros stérigmates; leur largeur atteint 15 µm à mi-hauteur.

Spores oblongues de face, elliptique de profil 17-21 x 8-10 µm ($\bar{x}$ = 18,45 ± 0,80 x 8,82 ± 0,50), à paroi très peu épaissie (0,3 à 0,5 µm dans KOH 3%) non cyanophile, ni amyloïde, au contenu gras.

Récoltes : SINGAPOUR: LY 8252 HOLOTYPE, sur Palmae, Mac Ritchie reservoir, 19 août 1977.

A les plus grandes spores parmi les Epithele à émergences squelettiques

Caractères culturaux d'E. malaiensis

SPORES.- uninucléées (LY 8252)

POLYSPERME.-

Croissance: extrêmement rapide (boîtes couvertes en une semaine)

Aspect: marge régulière . Mycélium aérien, blanc peu développé dans la partie jeune où il est réduit à une grosse pruine discontinue puis forme un feutre très mince, régulier, sur lequel sont dispersées des pustules coriaces d'aspect céracé puis recouvertes d'une couche crayeuse formant souvent bourrelet circulaire quand elle n'atteint pas le sommet au centre de la pustule. Sous le couvercle, mycélium blanc à aspect rhizoïde. Observée par transparence, la culture montre en outre quelques lignes blanches plus denses. Le revers des cultures est inchangé, l'odeur nulle.

Microscopie:

Mycélium aérien: hyphes grêles, x 0,8-1,2 µm, bouclées, à paroi mince, contenu homogène, cachant des hyphes, x 1,8-4,5 µ, bouclées.

- partie hyaline coriace, céracée, des pustules: hyphes ramifiées, densément enchevêtrées mais non soudées, x 2,5-3 µm, bouclées, à paroi réfringente un peu épaissie mais plus souvent au contenu dense, homogène, réfringent.

- partie recouvrante blanche: hyphes x 2-2,5 µm à paroi submince ou parfois nettement épaissie, bouclées non soudées, mais très intriquées en sorte de puzzle.

Mycélium submergé: hyphes, x 1,5-5-(6) µm, à paroi mince, contenu homogène et boucles constantes. Toutefois quelques hyphes bouclées à paroi nettement et irrégulièrement épaissie ont été rencontrées.
Les lignes blanches s'enfonçant dans la gélose sont constituées d'hyphes, x 2-2,5 µm, très intriquées en sorte de puzzle.

Boucles: constantes.

Cytologie: hyphes aux articles binucléés.
Oxydases: ac. gallique: +++,0 gaïacol: ++++, 0
p.- crésol: -, précipité blanc tyrosine: -, 0
CODE: 2a - 3c - (11) - 32 - 36 - 38 - 41 - 54 - 64.
Remarque. Cette culture de croissance extrêmement rapide est caractérisée par la formation de pustules céracées.

7. Epithele nikau G.H. Cunn., Trans. Roy. Soc. New Zeal. 83: 629, 1956.

Fig. 4 A

A la récolte, en petites taches séparées puis largement confluent, très étalé, blanc grisâtre (10 YR 7,75/1) à bordure blanche étroite; émergences nombreuses, concolores.

En herbier, adhérent, blanc plus ou moins crème (5 Y 8,5/3) couvert de petits aiguillons concolores nombreux jusqu'à la marge qui est très étroite, atténuée, blanchâtre.

En coupe, épais de 30-50-80 µm hors des émergences qui mesurent 180-230 x 12-25 µm et dépassent l'hyménium de 70-100-190 µm. Ces émergences sont côniques dans leur partie inférieure puis subcylindriques et sont formées d'hyphes rigides à paroi épaissie, x 1,8-2,2 µm, un peu rétrécies au sommet, assez congophiles, en faisceau régulier, le plus souvent enrobées d'une substance hyaline réfringente, cassante, non biréfringente qui englue les hyphes externes du faisceau. A la base l'émergence atteint le substratum en s'élargissant; elle est alors formée d'hyphes fibroïdes congophiles mais sinueuses ramifiées rappelant parfois des binding-hyphae (cf. Corner 1953).

La base est formée sur 15-18 µm d'hyphes génératrices horizontales, x 1,8-2 µm, régulières, à paroi mince, bouclées, auxquelles se mêlent hors des émergences de rares éléments squelettiques, qui se multiplient aux abords de celles-ci avant de s'emmêler entre elles pour former leur base.

Hyménium haut de 20-35 µm, formé de basidioles et basides riches en huiles; les basides ou podobasides larges, légèrement étranglées aux 2/3 supérieurs, mesurent 18-27 x 6-8 µm au sommet, et sont plus larges au 1/3 inférieur (x 7,5-9,5 µm). Elles portent 4 forts stérigmates souvent arqués. Quelques hyphes simples ou faiblement dendroides émergent entre les basidioles riches en gouttes grasses.

Spores ellipsoïdes de face, fusiformes de profil, 10-14 x 4,5-6 µm à paroi mince non amyloïde, ni cyanophile, au contenu guttulé; l'apicule est très réfringent; $\bar{x}$ = 12,16 ± 1,10 x 5,52 ± 0,35 pour 8004
12,43 ± 0,70 x 5,01 ± 0,27 pour 9119

Récoltes: GABON: LY 8004, sur Ancistrophyllum secundiflorum, La Mondah, 30 mai 1976; LY 9119, sur Eremospatha macrocarpa, id°, 20 janvier 1978, leg. G. Gilles 1406.

Caractères culturaux d'E. nikau

SPORES.- (LY 8004) uninucléées

GERMINATIONS.- Apparues quatre jours après la dispersion des spores LY 9119, elles ont permis 25 isolements.

MONOSPERMES.- A sept jours, les cultures montrent une majorité d'hyphes à cloisons simples, mais aussi de rares petiteshyphes bouclées. A un mois la moitié des cultures sont totalement bouclées et à 2 mois, toutes les cultures sont binucléées, à boucles constantes. L'espèce est donc présumée homothalle.

POLYSPERME.- (LY 8004, LY 9119)

Croissance: rapide (boîtes couvertes en trois semaines)

Aspect: la marge est régulière. Mycélium aérien blanc pur, appliqué, peu abondant, ne cachant pas totalement le milieu. Plus dense, feutré-ruguleux vers la bouture, il est partout ailleurs un peu rayonnant (LY 9119) à nettement rayonnant chez LY 8004 où il forme d'étroites fibrilles disposées très régulièrement et dans la partie jeune des cultures, ces fibrilles, serrées, parallèles, grimpent contre le bord des boîtes pour s'étaler ensuite sous le couvercle. Le revers des cultures est inchangé, leur odeur nulle.

Microscopie:

Mycélium aérien: hyphes, x 1-2,5-(4,5) µm, régulières, à paroi mince, boucles constantes. Les hyphes grêles, x 1-1,2 µ ont souvent des boucles un peu fortes. Dans le mycélium jeune, quelques hyphes sont incrustées; dans le mycélium âgé les dépôts de cristaux biréfringents sont plus importants.

Mycélium submergé: hyphes bouclées, les unes très grêles, x 1-1,2 µm très régulières, les autres plus larges, irrégulières, x 2,5-4-6 µm, à paroi mince, à contenu hétérogène. Celles-ci surtout nombreuses à faible profondeur montrent quelques renflements atteignant 10 µm. On peut aussi observer de rares hyphes à paroi, x 0,7 µm, également bouclées.

Boucles: constantes

Cytologie: hyphes aux articles régulièrement binucléés, bouclés.

Oxydases: ac. gallique: +++++, 0 gaïacol: +++++, 0
p.- crésol: -, fort précipité blanc tyrosine: -, tr à 5 mm

CODE: 2a - 3c - 32 - 36 - 38- 43 - 54 - 57 - 61

8. Epithele ovalispora Boidin et Lanquetin sp. nov.

Fig. 5

Jacens, membranacea, alba, margine paulum sub lente fibrillosa, acubus exilibus hirta, 100-400 µm crassa. Emergentiis 150-280 x 30-35 µm, ex hyphis tunica incrassata, rigidis, tenui strato hypharum fibulatarum, tunica tenui circumdatis constantibus. Trama ex hyphis genetricibus fibulatis. Basidiis 45-55 x 10-13 µm, 4 grandibus sterigmatis. Sporis ovatis, 13,5-17,5 x 8,5-11 µm, tunica haud amyloidea neque cyanophila. In Palmaceis. Holotypus LY 7928. Gabon.

A la récolte, étalé, membraneux mais adhérent, à marge un peu fibrilleuse radiée sous la loupe, hispide par des aiguillons nombreux, longs et effilés, blanc.

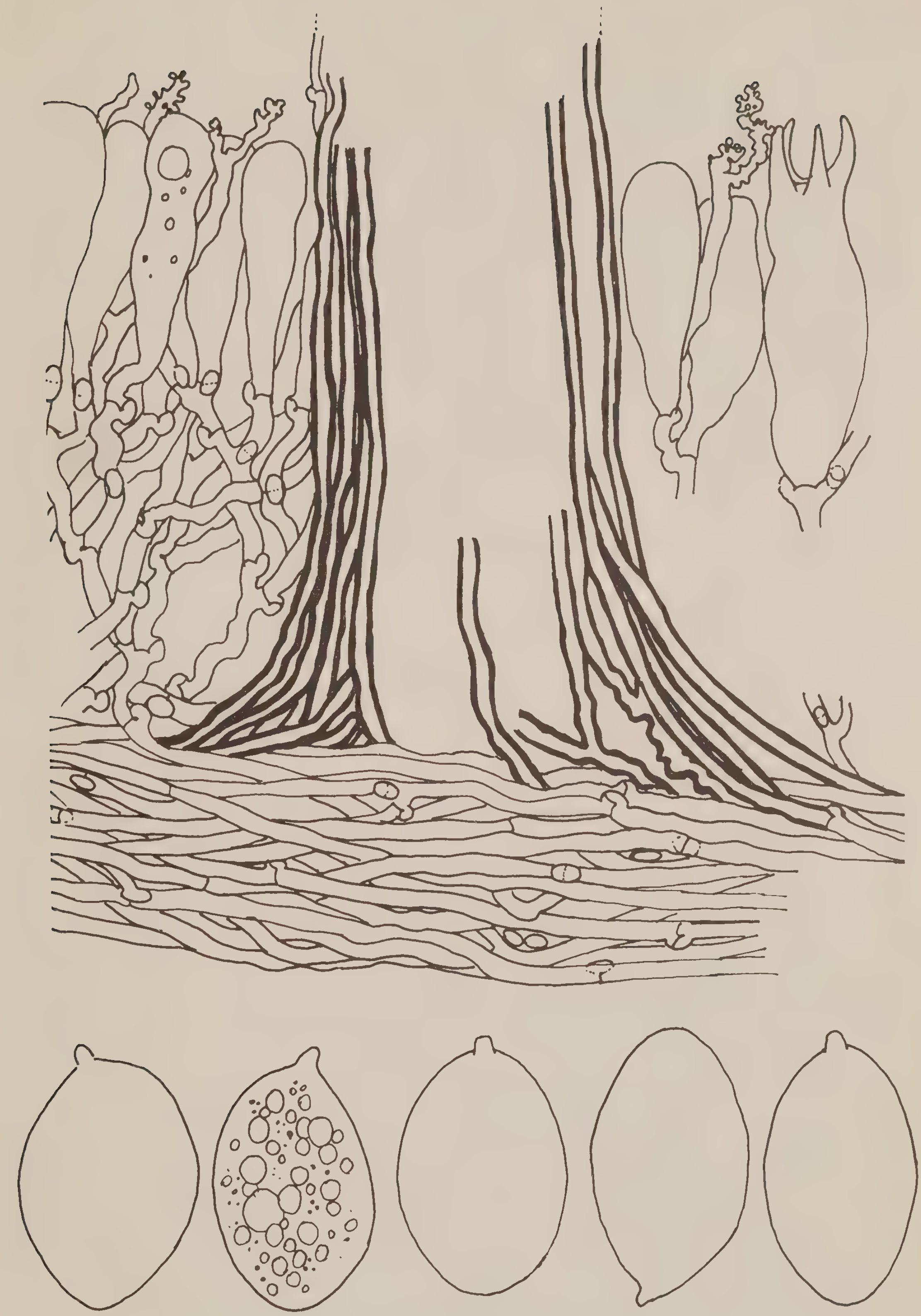

Figure 5: Epithele ovalispora sp.nov.: coupe montrant la base d'une émergence, et spores (holotype LY 7928).

En herbier, il a le même aspect mais il est teinté de crème (vers 2,5 Y 9/3) sauf à la marge blanche et sans émergence sur 0,5 mm environ.

En coupe, épais de 100-140 µm dont les 30-40 µm inférieurs forment une couche d'hyphes basales horizontales: ce sont des génératrices à paroi mince ou submince, bouclées, x 2-3-(3,8) µm. Au sommet de la couche inférieure naissent d'une part les émergences, d'autre part les hyphes sous-hyméniales assez lâches, x 2,5-5 µm bouclées.

Les émergences sont côniques, longues de 150-230-280 µm, étroites, elles débordent de 70-160-(230) µm et sont larges de 30-35 µm à la sortie de l'hyménium; elles sont constituées d'hyphes, x 2 µm environ, d'aspect fibreux, congophiles et assez dextrinoïdes et cyanophiles, à paroi assez épaissie, serrées parallèlement en faisceau dans la partie émergente; à la surface des émergences ont peut voir une mince couche d'hyphes génératrices bouclées.

Basidioles largement claviformes, larges de 10-14 µm, riches en huile. Certaines (en arrêt de végétation?) ont une paroi épaissie. Entre les basidioles émergent des hyphes dendroïdes grêles, x 2 µm environ. Basides larges, 45-55 x 10-13 µm au sommet, plus larges plus bas (x 14-15 µm), à 4 forts stérigmates 15-16 x 3,5-4 µm.

Spores ovoïdes de face, au contenu gras, 13,5-17,5 x 8,5-11 µm ($\bar{x}$ = 15,05 ± 1,12 x 9,70 ± 0,65) à paroi non amyloïde, ni cyanophile; en masse, la sporée est teintée d'orange brunâtre.

Récoltes: GABON: LY 7928 HOLOTYPE, sur *Ancistrophyllum secundiflorum*, rive gauche de l'Ivindo, Makokou, le 24 mai 1976.

Caractérisé par des émergences longues et côniques, insérées à mi-hauteur dans le champignon et aux hyphes congophiles et cyanophiles, et sutout, par ses spores.

9. *Epithele sp.* LY 5697 d'Argentine

Fig. 6 A

En herbier, membraneux, blanc crème, détachable, comme posé sur un subiculum aranéeux lâchement feutré formant une étroite marge amincie blanche; couvert sous la loupe d'aiguillons grêles, nombreux.

En coupe épais de 200-300 µm avec couche inférieure lâche très développée supportant un hyménium dense, épais de 50 µm environ.

Emergences 70-120 x 30-50 µm, formées d'hyphes x 2-3 µm bouclées, à paroi mince ou un peu épaissie parfois ramifiées, souvent terminées en éléments dendroïdes; dans l'axe de ces émergences on peut voir quelques hyphes à paroi épaisse, certaines sont des hyphes bouclées sur leur parcours, d'autres peu nombreuses sont des extrémités fibroïdes. Ces émergences portent des dépôts de cristaux.

La couche inférieure est formée d'hyphes très distinctes, les génératrices bouclées, larges de 2-5 µm, à paroi mince ou un peu épaissie, mais facilement collapsées, hyphes squelettiques régulières, x 3-3,5 µm à lumen subnul.

Basides claviformes puis subcylindriques, 28-37 x 6-7 µm, à 4 gros stérigmates.

Spores ellipsoïdes, 10-12 x 5-6,5 µm, avec apicule brillant, à paroi mince ou faiblement épaissie, non amyloïde, ni cyanophile.

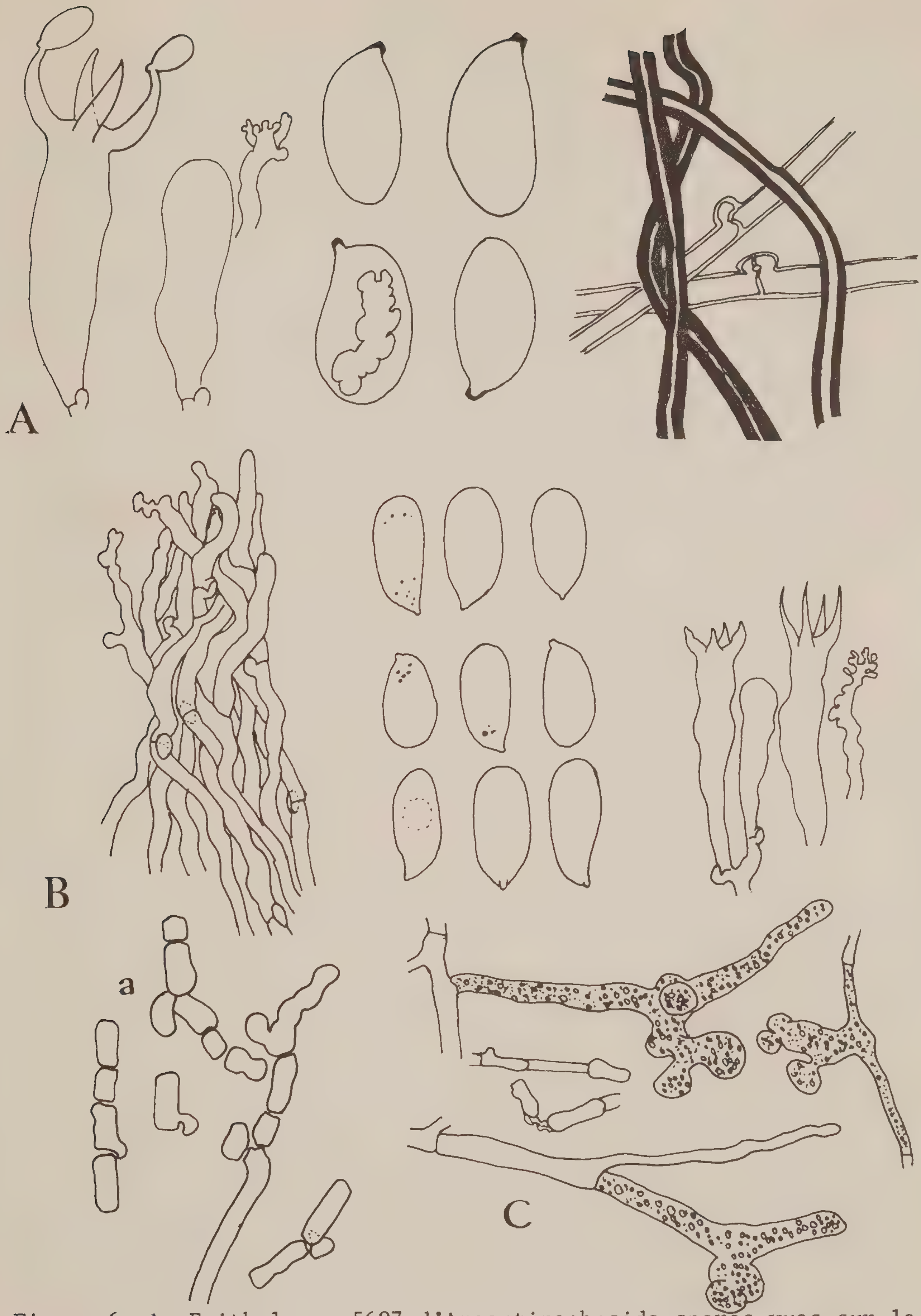

Figure 6: A- Epithele sp.5697 d'Argentine:baside,spores vues sur le basidiome et hyphes du contexte(Congo ammoniacal).

B- Pteridomyces lacteus sp.nov.:sommet d'une émergence, spores(holotype LY 9334)et basides;a-arthrospores en culture.

C- Vesiculomyces epitheloides: sulfocystides et sorte d'arthrospores en culture (LY 9677,paratype).

Récolte: ARGENTINE, sur bois sec, El Soberbio, Misiones, 28 avril 1966, leg. C.E. Gomez.

Cette espèce a été signalée ici car elle diffère assez nettement des Epithele décrits ci-dessus. Son contexte lâche avec hyphes squelettiques dominantes, ses émergences pourvues, au contraire, de quelques hyphes squelettiques enrobées d'hyphes bouclées qui ne semblent pas s'enraciner profondément, en font une espèce marginale bien typée; elle mériterait d'être décrite, mais a pu l'être dans un autre genre (Hydnum peut-être) par d'anciens auteurs latino-américains... ce qui nécessiterait une révision de nombreux types difficilement localisables.

II - Genre Pteridomyces Jülich 1979 emend.

Champignons étalés, à marge adhérente, ornés d'émergences stériles granuliformes ou odontioïdes nées soit en surface, soit plus ou moins profondément; contexte et émergences monomitiques ou dimitiques. Dendrophyses ou hyphes dendroïdes. Basides claviformes petites 15-20-(30) x 4-5 µm, à (2)-4 stérigmates. Spores petites (moins de 9 µm de longueur), à paroi mince, ni amyloïde, ni cyanophile.

10. Pteridomyces lacteus Boidin, Lanquetin et Gilles sp. nov.

Fig. 6 B

Orbicularis, deinde confluens, late expansus, adhaerens, e cretaceo albus vel pallidissime cremeus, 40-100 µm crassus. Emergentiis cylindratis, brevibus, 50-75 x 20 µm eminentibus. Trama monomitica, fibulata. Basidiis 22-30 x 5 µm, (3)-4 sterigmatis exilibus 7-8 µm longis, nonnulis hyphis dendroideis intermixtis. Sporis ellipsoideis, 6-8 x 3-4 µm, tunica tenui, haud amyloidea neque cyanophila. In ligno. Holotypus LY 9334. Gabon.

A la récolte, orbiculaire puis confluent, blanc de craie ou à peine jaunâtre (2,5 Y 8/0,5) avec marge amincie.

Emergences courtes, cylindriques, larges de 15-20 µm.

En herbier, largement étalé, mince très adhérent, blanc à crème très pâle, à marge nette, amincie sur 0,2-0,4 mm, blanche. Emergences petites, visibles sous la loupe comme de minuscules aiguillons concolores régulièrement répartis sauf vers la marge.

En coupe, épais de 40-100 µm avec émergences atteignant 100 µm de longueur totale, débordant de 50-75 x 12-20 µm. Monomitique: une couche basale haute de 10-20-(30) µm est formée d'hyphes horizontales à paroi mince ou submince, régulières, bouclées, x 2,5-3,8 µm; se dressent ensuite un sous-hyménium fait d'hyphes semblables plus ramifiées et un hyménium fait de basidioles claviformes étroites et de petites basides 22-30 x 5 µm, à 3-(4) stérigmates longs de 7-8 µm. Entre les basidioles peuvent émerger des hyphes dendrophysoïdes. Les émergences sont faites d'hyphes à paroi mince, ou à peine épaissie dans la partie immerse, un peu sinueuses, bouclées, x 2-3 µm.

Spores ellipsoïdes inégalement attenuées (de profil) vers l'apicule, 6-8 x 3-4 µm, à paroi non amyloïde. ($\bar{x}$ = 7,01 x 3,22 pour le type, 7,25 x 3,60 pour LY 9338).

Récoltes: GABON: LY 9334, HOLOTYPE, sur bois mort tombé de dicotylédone, fourré littoral à 14 km au N. de Libbreville, 5 mai 1979, leg. G. Gilles 1574 ; LY 9338, ibid., leg. G. Gilles 1576.

Caractères culturaux de Pteridomyces lacteus

SPORES.- uninucléées (LY 9334, HOLOTYPE)

GERMINATIONS.- (LY 9334 et 9338). Elles apparaissent 3 ou 4 jours après la dispersion, 30 isolements 9334 et 8 de LY 9338 ont été effectués.

MONOSPERMES.- Ils sont formés d'hyphes aux articles uninucléés, sans boucles. L'appariement des monospermes 9334 n'a pas permis de définir le type de thallie avec certitude. Il se dégage une tendance tétrapolaire. Les monospermes LY 9334 sont totalement intercompatibles avec les monospermes LY 9338.

POLYSPERME.- LY 9334.

Croissance: très rapide (boites couvertes en deux semaines)

Aspect: La marge est très régulière. A 6 semaines, sur un milieu irrégulièrement teinté de bai (2,5 YR 4/6) ou de châtain (2,5 YR 3/4), on observe un mycélium subfeutré, velouté, blanc à crème rosé (5 YR 8/3) de densité variable, beaucoup plus faible sur les zones de milieu brun rougeâtre qu'il ne cache pas totalement. Dans d'autres cultures, on observe deux parties très contrastées: une grande plage de mycélium subfeutré blanc sur milieu non teinté et une grande zone, englobant la bouture, où le milieu bruni est recouvert d'un mycélium alutacé (10 YR 8/4 à 8 YR 7/6). Le revers des cultures est teinté de brun roux par plages, l'odeur est nulle.

Microscopie:

Mycélium aérien: dans les parties blanches, il forme une peau constituée de nombreuses hyphes superficielles très grêles (qui sont en fait des hyphes collapsées) cachant des hyphes x 2-4 µm, régulières, à paroi mince et boucles constantes. Dans les jeunes cultures, certains rameaux se désarticulent en arthrospores (cf. fig. 6 B a).

Dans les parties teintées, le mycélium superficiel coloré est formé d'hyphes bouclées, parfois x 1-1,5 µm mais jusqu'à 8-9 µm. Certaines, x 1,8-4 µm, ont une paroi épaissie comme rigide, très réfringente, jaune orangé, elles portent des gouttes résinoïdes de même couleur ou sont remplies de cette substance. Elles peuvent former des amas denses brun doré sous le microscope. Après trois mois, les zones teintées montrent sous une mince couche d'hyphes affaissées, une croûte coriace, impossible à dilacérer; elle se casse montrant sur les bords des hyphes irrégulières, très intriquées, à paroi épaisse, réfringente et au contenu jaune doré.

Mycélium submergé: hyphes, x 2-5-(8) µm, souvent larges, régulières ou parfois irrégulières (difformes, renflées), à paroi mince et boucles constantes. Localement des masses compactes sont formées d'hyphes bouclées, serrées, intriquées, x 3 µm environ, hyalines à brun doré, à paroi épaisse à très épaisse plus ou moins gélifiée.

Boucles: constantes.

Cytologie: hyphes aux articles binucléés et bouclés.

Oxydases: ac. gallique: +++++, 0 gaïacol: ++++, 0
p.- crésol: -, précipité blanc tyrosine: -, 5 mm
CODE: 2a - 3c - 35 - 37 - 39 - 42 - 54 - 58 - 61
Remarque. Cette culture est caractérisée par ses plages brun-rougeâtres, la formation d'arthrospores, et la présence d'amas denses en mycélium submergé.

11 - Pteridomyces roseolus Boidinet Lanquetin sp. nov.
Fig. 7

Erumpens, jacens, subceraceus firmus, e roseo griseus, permultis emergentiis gracillimis coopertus, 35-50 µm crassus. Emergentiis 50-65 x 15-20 µm transgredientibus, in medio ex hyphis tunica incrassata et extus ex hyphis fibulatis, tunica parum incrassata constantibus. Hyphis basalibus subhymenialibusque fibulatis, tunica tenui. Basidiis 18-20 x 3,8-5 µm. Sporis subcylindratis, 5-6 x 2-2, 5 µm, tunica haud amyloidea neque cyanophila. In ligno. Holotypus 5377. Centrafrique.

A la récolte, érompant, étalé, mince, subcéracé ferme, gris rosé (5 YR 6/2, 6/3) couvert sous une forte loupe de multiples émergences grêles, hyalines.

En herbier, aride, beige pâle (vers 10 YR 7,5/2) à émergences pâles, serrées, grêles, à peine visibles sous la loupe.

En coupe, épais de 35-50 µm entre les émergences posées sur le support et mesurant dans leur totalité 90-100 µm de longueur; elles émergent donc de 50-65 µm; leur forme est un peu cônique, leur largeur est de 15-30 µm au niveau des basides.

Les émergences sont solides, formées d'hyphes cohérentes très difficiles à écarter; elles sont formées en surface d'hyphes x 2 µm, bouclées, parfois ramifiées, à paroi un peu épaissie; les hyphes plus profondes ont une paroi plus épaisse et nacrée. Après traitement ammoniacal à 60°C les hyphes des émergences apparaissent très sinueuses à la base, larges de 1,5-2 µm, à paroi très épaissie (gonflée?), très congophile et à lumen indiscernable; si on les place dans le bleu après ce traitement ammoniacal à chaud, le lumen bleuté n'est net que sur les hyphes de surface, les autres en semblent dépourvues.

Entre les émergences on voit des hyphes grêles x 1,5-2 µm, serrées, plus ou moins ascendantes, à paroi mince ou un peu épaissie, bouclées, formant une couche basale localement bourrée d'amas de cristaux, et une zone hyméniale constituée de petites basidioles claviformes bouclées et de quelques hyphes émergentes non dendroïdes.

Basides 18-20 x 3,8-5 µm à 4 stérigmates.

Spores subcylindriques, 5-6,2 x 2-2,5 µm à paroi mince, non amyloïde, ni cyanophile.

Récolte: REPUBLIQUE CENTRAFRICAINE: LY 5377, HOLOTYPE sur bois mort,
La Maboké, 10 mai 1965.

Il est difficile ici de se prononcer sur la nature squelettique ou non des hyphes des émergences. Après traitement ammoniacal à 60°C les hyphes congophiles et à paroi très épaissie, qui constituent l'essentiel des émergences, rappellent les hyphes "squelettiques" caractéristiques des émergences de Skeletohydnum. Une observation directe à froid montre clairement que la surface des émergences est constituée d'hyphes génératrices bouclées parfois ramifiées mais l'intérieur

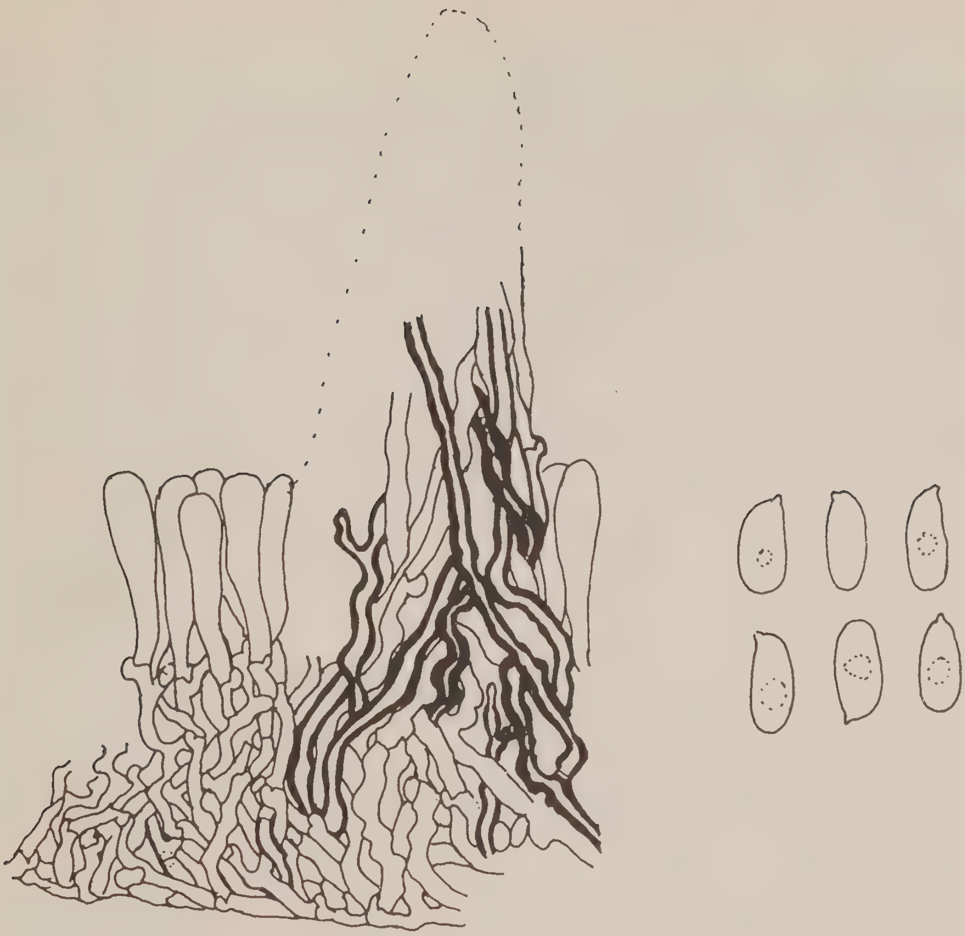

Figure 7: *Pteridomyces* *roseolus* sp.nov.: coupe du basidiome , avec détail d'une partie d'une émergence (Ammoniaque 60°C puis Bleu Coton); spores (holotype LY 5377).

est alors formé d'hyphes très réfringentes, solidement accolées, que l'on ne peut disjoindre et distinguer individuellement sur d'assez longs parcours. Basides et spores sont du type *Pteridomyces*.
On aurait donc ici un *Pteridomyces* à émergences constituées d'hyphes squelettiques ou au moins à nette tendance squelettique. Nous l'avons retenu ici, bien que nous ne disposions que d'une seule récolte, parce qu'il pose le problème de l'utilisation du "mitisme" dans la définition des genres *épitheloïdes*.

12. "Pteridomyces" sp. 8270 de Singapour

Cette récolte de Singapour n'est citée ici que parce qu'elle pose elle aussi le problème du mitisme chez les Pteridomyces. N'ayant pas sporulé après la récolte, nous ne voulons en faire une récolte type.

En herbier, étalé, très adhérent, mince, beige sale (10 YR 7/2,5) à marge amincie sur un ou deux millimètres, grisâtre (vers 5 YR 7/1), couvert sous une forte loupe de petites émergences concolores ou à sommet bruni, serrées, éparses ou alignées.

En coupe, épais de 70-170 µm entre les émergences, il est constitué d'hyphes serrées, peu distinctes, à paroi souvent épaissie, bouclées, qui portent des basidioles claviformes petites et des basides d'environ 14 x 4,5 µm, à 4 stérigmates longs de 4 à 5 µm.

Les émergences, très nombreuses, débordent de 50-70 x 15-30 µm; elles sont ancrées profondément et constituées d'hyphes squelettiques congophiles raides, x 1,5-3 µm, à lumen étroit; ces émergences sont recouvertes de dépôts cristallins.

Spores (vues en petit nombre) oblongues, 3,5-4 x 2,5-2,8 µm, non amyloïdes, ni cyanophiles.

Récoltes: SINGAPOUR: LY 8270, sur bois, Mac Ritchie Reservoir, 19 août 1977.

Cette récolte rappelle beaucoup par son aspect P. roseolus.

Par ses basides et ses spores il appartiendrait au genre Pteridomyces mais ses émergences sont constituées d'hyphes squelettiques tout à fait typiques comme chez les meilleurs Skeletohydnum.

13. Pteridomyces sphaericosporus Boidin, Lanquetin et Gilles sp. nov.

Fig. 8

Jacens, e griseolo albus, dein alutaceus, lentus, spongiosus, emergentiis albidis hirtus. 150-180 µm crassus inter emergentias, quae 60-90 x 20-30 µm transgrediuntur. Strato inferiore laxo, ex hyphis fibulatis tunica crassa sicut in emergentiis constante. Basidiis 18-20 x 4 µm. Sporis subglobosis, 4,5-5,6 x 3,8-4,8 µm, tunica paulum crassa, haud cyanophilis neque amyloideis. In ligno. Holotypus LY 7377. Côte d'Ivoire.

A l'état frais, largement étalé, blanc grisâtre (10 YR 8/1) mais devenant pâle alutacé (10 YR 8/3,5) dès qu'il sèche; coriace, spongieux, très hérissé d'émergences blanchâtres; marge concolore, abrupte ou amincie.

En herbier, étalé, adhérent, alutacé (10 YR 8/4 à 7,8/4) finement granuleux sous la loupe où il apparaît aranéeux dense plus poruleux, enfin continu avec émergences subcylindriques un peu plus pâles apparaissant dès la marge irrégulièrement groupées, parfois juxtaposées ou connées par trois ou quatre.

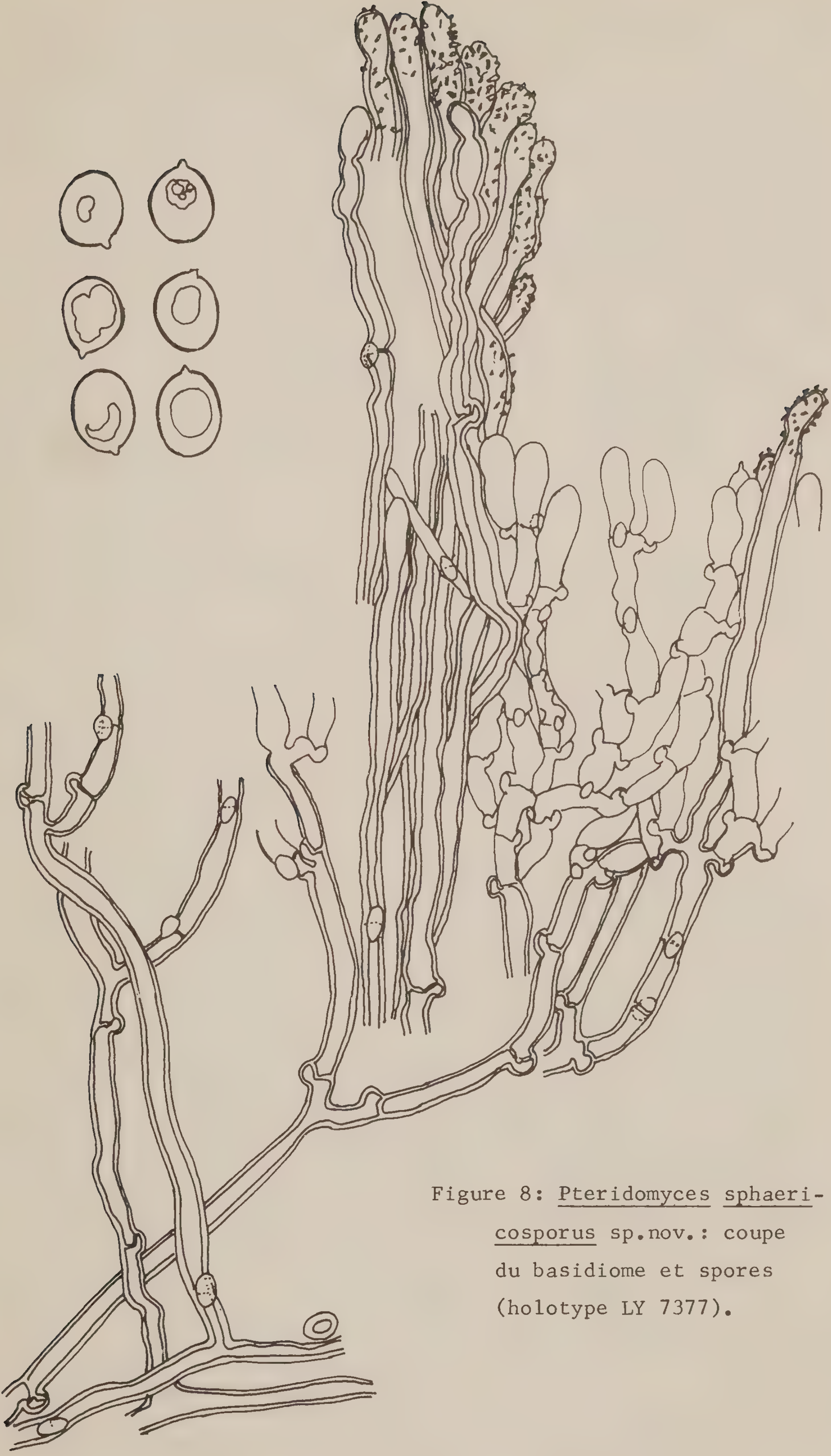

Figure 8: *Pteridomyces sphaericosporus* sp.nov.: coupe du basidiome et spores (holotype LY 7377).

En coupe, épais de 150-180 µm, sous les émergences qui mesurent 60-90 x 20-30-(40) µm; il est nettement constitué de deux parties: une couche inférieure lâche, haute de 100-120 µm, formée d'hyphes en tous sens et d'un hyménium dense épais de 60 µm environ. La couche inférieure est faite d'hyphes très distinctes, régulières, bouclées, à paroi très épaisse, hyaline, larges de 2-4 µm, ramifiées. Leur paroi reste nettement épaissie après les premières ramifications qui forment le sous-hyménium. Sous-hyménium aux articles beaucoup plus courts, à paroi mince ou un peu épaissie, aux boucles étroites.

Basides subcylindriques, 18-20 x 4 µm, à 4 stérigmates de 2-2,5 µm de longueur. Très souvent les éléments hyméniens, hors végétation, contiennent des hyphes à l'intérieur, à paroi mince, souvent ratatinées.

Emergences constituées par des faisceaux d'hyphes x 4 µm environ, à paroi hyaline très épaissie (1 à 1,5 µm), nées souvent très bas, bouclées sur leur parcours, souvent sinueuses ou étranglées et plus ou moins moniliformes, piquetées de cristaux sur les 30 µm terminaux.

Spores subsphériques à un peu ovoïdes, 4,5-5,5 x 3,8-4,8 µm, ($\bar{x}$ = 4,98 ± 0,33 x 4,20 ± 0,25) à paroi un peu épaisse, non amyloïde, ni cyanophile, contenant un globule gras.

Récolte: COTE D'IVOIRE, LY 7377, HOLOTYPE sur bois, en forêt du Téké, 7 juillet 1974, leg. G. Gilles 248.

Facile à reconnaître à ses spores et à sa structure, ce qui en fait un membre assez marginal du genre *Pteridomyces*.

III - Un champignon épitheloïde à spores amyloïdes

Il nous reste à décrire un champignon malgache qui n'entre pas dans les genres étudiés ci-dessus. Il possède, émergences mises à part, les caractères du genre *Gloeocystidiellum* Donk.

Ce genre était certes commode mais hétérogène comme l'ont signalé divers auteurs tel Boidin (1966) dans un tableau hypothétique (pl. II) des relations des espèces de ce genre avec diverses familles. Depuis, des coupures successives ont été proposées: genres *Scytinostromella* Parmasto (1968), *Vesiculomyces* Hagström (1977), *Megalocystidium* Jülich (1978), *Conforticium* Hallenberg (1980), *Boidinia* Stalpers et Hjortstam (1982). Il semble que le genre *Megalocystidium* comprenne les espèces à spores lisses -ce qui n'est pas dit dans la diagnose originale, qui ne signale aucun caractère distinctif par rapport à *Gloeocystidiellum porosum* type du genre démembré, mais qui a, lui, des spores ornées.- En effet le type de ce nouveau genre, *M. leucoxanthum* et les deux autres espèces transférées par Jülich, *M. lactescens* et *luridum*, ont des spores lisses. Mais c'est aussi le cas du genre *Vesiculomyces* Hagström proposé antérieurement. Son auteur le caractérise avant tout par ses gloeocystides sulfoaldéhyde négatives. *V. citrinus* possède en fait des gloeocystides très précocement vides dans le carpophore, mais qui, en culture, ont un contenu sulfo-positif (Boidin 1958 p. 109).

L'absence de boucles, autre caractère proposé comme distinctif se retrouve chez *G. lactescens* (un *Megalocystidium* pour Jülich) et *G. humile*. Nous ne voyons donc aucune raison pour ne pas synonymiser *Megalocystidium* à *Vesiculomyces* antérieur d'une année.

Genre *Vesiculomyces* Hagström (Bot. Nat. 130: 53, 1977) emend.

Ce genre est réservé aux *Gloeocystidiellum* monomitiques à spores amyloïdes lisses, pourvus de gloeocystides montrant le plus souvent un contenu riche, pouvant réagir aux sulfo-aldéhydes, contenu qui parfois cependant disparaît précocement dans le basidiome. Les hyphes sont avec ou sans boucles. Contrairement au genre *Conferticium* Hallenberg, ici les hyphes ne sont pas cyanophiles et les basides ne repoussent pas à l'intérieur de basides anciennes (répétobasides).

Le type est *Vesiculomyces citrinus* (Pers.) Hagström.

Autres espèces: *Vesiculomyces Chelidonium* (Pat. Bull. Soc. Mycol. France, 16: 180, 1900, ut *Corticium*) Boidin et Lanq. nov. comb., *V. humilis* (Boidin, Cah. Maboké, 4: 9, 1966, ut *Gloeocystidiellum*) nov. comb.; *V. leucoxanthus* (Bres. Fungi Trid. 2: 57, 1898, ut *Corticium*) nov. comb.; *V. lactescens* (Berk. ap. Smith Engl. Fl. 5,2: 169, 1836, ut *Thelephora*) nov. comb.; *V. luridus* (Bres. Fungi Trid. 2: 59, 1898, ut *Corticium*) nov. comb.; *V. sulcatus* (Rehill et Bakshi, Indian For. Bull. 242: 15, 1965, ut *Corticium*) nov. comb.

14. *Vesiculomyces epitheloides* Boidin, Lanquetin et Gilles sp. nov.

Fig. 9

Jacens, amplus, solidus, rigescens, salmoneus, ora alba fibrillosa, 300-350 µm crassus. Emergentiis granuliformibus 60-70 x 20-60 µm eminentibus, crassamentis crystallinis uberibus. Hyphis jacentibus, angustis, simplicibus septis, stratum ad 50 µm crassum constituentibus; hyphis subhymenialibus angustis, resurgentibus tunica incrassata; hymenio increscente e gloeocystidiis obtusis, 150-250 x 10-20 µm, sulfoaldehydibus nigrescentibus, atque basidiis 45-60 x 6-8 µm, tetrasporis constante. Emergentiis ex hyphis parallelis, x 2-3,25 µm, tunica subtenui, vel paulum incrassata constantibus, sporis reniformibus, 6,5-8 x 4,5-5,5 µm. Holotypus LY 9761, Madagascar.

A la récolte, étalé, étendu, solide, saumoné (7,5 YR 7/4 à 8/6, salmon buff R.) avec bordure fibrilleuse blanche pouvant atteindre 3 mm de largeur; sous la loupe il est constellé de petites émergences concolores.

En herbier, très adhérent, assez corné, uniformément isabelle (7,5 YR 6,8/4,5), avec marge amincie, ocre alutacé (10 YR 8/6, warm buff), puis fibrillo aranéeuse; sous la loupe très nombreuses émergences assez régulièrement disséminées, petites, granuliformes, concolores.

Coupe haute de 300-350 µm sans les émergences qui dépassent de 60-70 µm et sont larges de 20-60 µm, brillantes par les amas de gros cristaux qu'elles portent. Sur 50 µm environ d'hyphes horizontales, étroites, x 1,5-2,5-(3) µm à paroi mince ou un peu épaissie à cloisons simples, serrées mais non soudées entre elles, une zone de transition formée d'hyphes obliques similaires à paroi souvent plus nettement épaissie, porte un hyménium crassescent haut de 180-250 µm formé d'énormes gloeocystides obtuses, irrégulièrement subcylindriques, 150-250 x 10-20 µm, au contenu réfringent sulfoaldéhyde positif, à paroi épaissie dans la moitié inférieure, pouvant montrer quelques

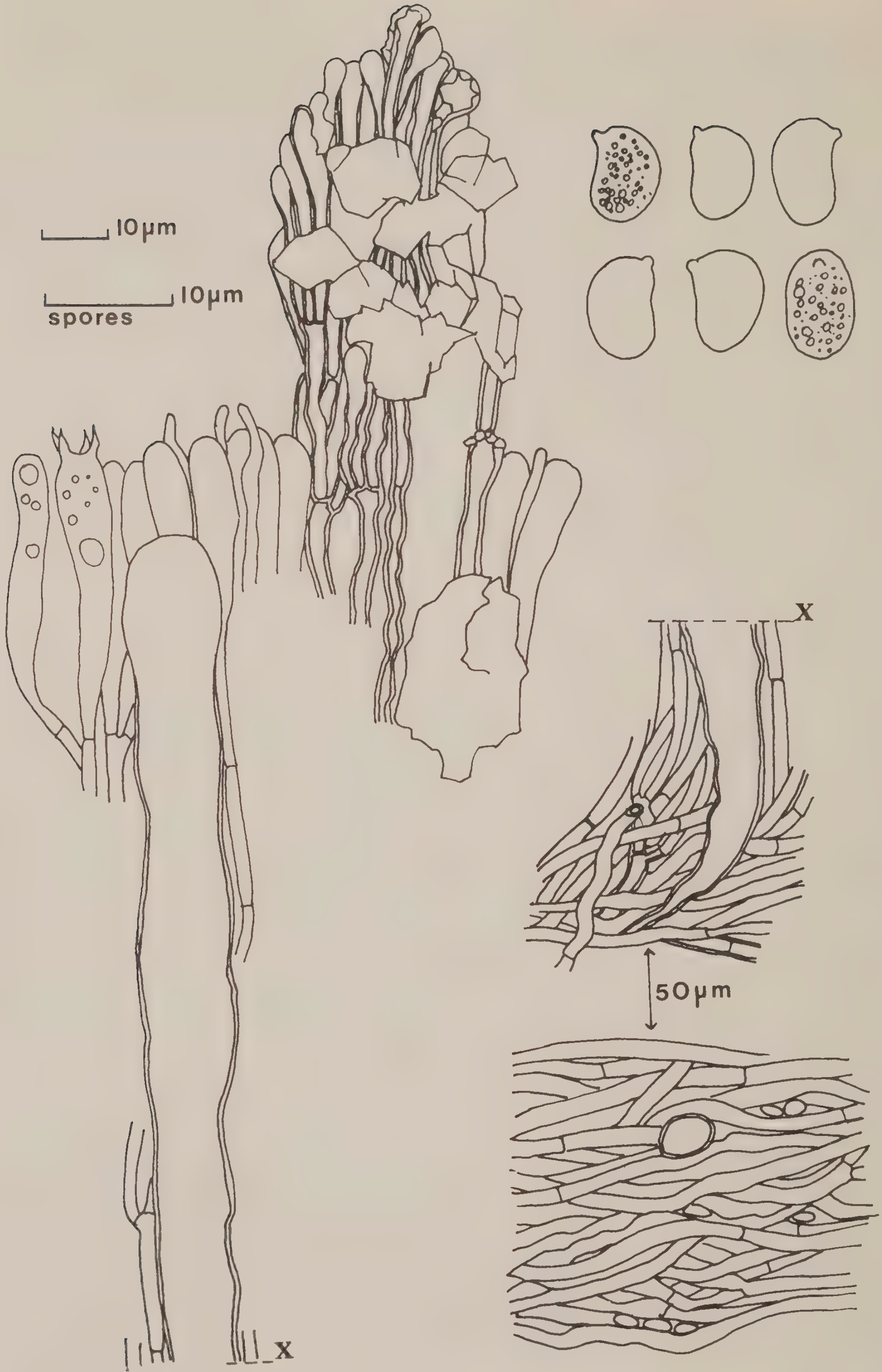

Figure 9: Vesiculomyces epitheloides sp.nov.:base du basidiome , catahyménium (X signale un raccord),émergence et spores (holotype LY 9761).Coupe montée dans le Bleu lactique.

cloisons de retrait, d'hyphes grêles x 2-3 µm à paroi mince pouvant émerger entre les basidioles, et de basides étroitement claviformes, à paroi mince, sans boucle à la base, 45-60 x 6-8 µm à 4 stérigmates.

Les émergences sont formées d'hyphes parallèles, larges de 2-3,25 µm, à paroi submince mais apparaissant épaissie (0,8 µm environ) après traitement ammoniacal à 60°C, ramifiées, parfois un peu élargies au sommet, mêlées à des amas de gros cristaux. Les émergences "s'enfoncent" dans l'hyménium jusqu'à 200 µm sous la surface.

Spores blanches en masse, réniformes, 6,5-8 x 4,5-5,5 µm, ($\bar{x}$ = 7,49 ± 0,61 x 4,95 ± 0,23), à paroi lisse, mince, amyloïde, mais non cyanophile et au contenu guttulé gras.

Récolte: MADAGASCAR: LY 9677, sur une souche sous un buisson, alt. 1250 m, La Mandraka, 29 mars 1981, leg. G. Gilles n° 28; LY 9761, ibid. 11 avril 1981, leg. G. Gilles n° 46, HOLOTYPE.

Caractères culturaux de Vesiculomyces epitheloides

SPORES.- (LY 9677, 9761: Holotype), binucléées

MONOSPERMES.- Très peu de spores ont germé. Deux germinations 9761 et 6 germinations 9677 ont été isolées respectivement 8 et 15 jours après la dispersion des spores. Ces cultures monospermes sont formées d'hyphes régulières, sans boucles, aux articles uninucléés. Elles montrent des éléments de forme irrégulière au contenu densément guttulé, sulfo-aldéhyde positif et des hyphes étroites qui se désarticulent en arthrospores.

Tests d'intercompatibilité: toutes les confrontations de monospermes 9761 avec 9677, produisent un mycélium formé d'hyphes aux articles régulièrement binucléés. L'espèce est donc hétérothalle et les deux récoltes 9761 et 9677 sont intercompatibles (cf. Lanquetin 1973).

POLYSPERMES.-

Croissance: extrêmement lente (ne couvre pas la moitié de la boîte en six semaines)

Aspect: Marge irrégulière, plus ou moins lobée puis mycélium aérien, blanc léger puis floconneux (pouvant aussi former des bourrelets concentriques) formant dans la partie âgée 1 couche lisse ou bosselée-grumeleuse, de mycélium blanc à ocre alutacé pâle (7,5 YR 7,5 à 8/4, à 10 YR 8/4) ou alutacé chamois (10 YR 8/6 à 7,5/6) sur les reliefs. Le revers des cultures est inchangé; leur odeur faible, agréable, constante.

Microscopie:

Mycélium aérien: il montre

- des hyphes, x 1,2-3-(4) µm, régulières, à paroi mince, aux cloisons simples
- de nombreuses gloeocystides de tailles et formes très variées, avec renflements: x 2,5-5-(10) µm (cf. fig. 6 C). Leur contenu réfringent, densément guttulé ou pailleté dans le rouge congo, réagit très positivement dans les sulfo-aldéhydes. Aucune schizopapille n'a été observée
- quelques hyphes avec cloisons de retrait qui se désarticulent en arthrospores (cf. dessin)

Mycèlium submergé: dans le premier millimètre de gélose un peu coriace à couper, le mycélium dense montre des hyphes régulières, x 1,8-3-(4) µm, à paroi mince, sans boucles et de nombreuses gloeocystides au contenu dense ou pailleté. Plus profondément on observe encore des éléments gloeocystidiens, mais moins nombreux et de forme plutôt noduleuse.

Boucles: absentes

Cytologie: les cultures polyspermes sont constituées d'hyphes aux articles régulièrement binucléés

Oxydases: acide gallique: ++++,0 gaïacol: +++,0
p.- crésol: - tyrosine: +++,0

CODE: 6 - 7 - 15a - 35 - 36 - 38 - 47 - 53 - 54 - 58 - 61

Remarque. Cette espèce qui exhale une nette et constante odeur agréable est caractérisée par sa croissance extrêmement lente, ses nombreuses sulfocystides irrégulières sans schizopapilles, la présence d'arthrospores (surtout visibles en culture sur lame) et son comportement hétérothalle sans boucle.

Si les myceliums des Epithele et Pteridomyces ont une croissance aisée, les germinations des spores en semis clairs ont été beaucoup plus difficiles à obtenir avec des spores qui certes avaient voyagé plusieurs jours. Notons toutefois que E. nikau et guadelupensis sont homothalles lents, E. efibulata, parthénogénétique et P. lacteus, hétérothalle. La présence de laccase laisse supposer que toutes les espèces sont à pourriture blanche quant à Vesiculomyces epitheloides, il est hétérothalle sans boucles, comme le type du genre V. citrinus, ainsi que V. lactescens et ses gloeocystides sulfoaldhéydes très positives en culture contiennent du stearyl-velutinal (K. Gluchoff-Fiasson, viva voce).

REMERCIEMENTS

Nos remerciements s'adressent tout d'abord à notre ami Gérard Gilles à qui nous devons de nombreuses récoltes africaines et malgaches citées ici, accompagnées de sporées, de notes sur le frais, avec données microscopiques. Nous exprimons, en outre, notre gratitude envers les directeurs du Jardin Botanique de l'Etat de Bruxelles et de l'Herbier de Kew, nos collègues R.A. Maas Geesteranus et A.L. Welden pour leur lecture critique de notre manuscrit , et à Monsieur H. Romagnesi pour les nombreuses diagnoses latines incluses ici et, pour lesquelles il a bien voulu nous faire profiter, une fois encore, de sa maîtrise de cette langue.

SUMMARY

We have studied the effused and epitheloid fungi collected in warm countries. The fourteen species described in this paper cannot be included in the four genera *Epithele* (Pat.) Pat. (1900). *Epithelopsis* Jülich (1976), *Pteridomyces* Jülich and *Skeletohydnum* Jülich (1979), as definited by Jülich.

As already noticed by Patouillard (1899), sterile pegs occur in some tremellaceous Heterobasidiomycetes (genus *Heterochaete*), and also in a few Homobasidiomycetes such as *Mycobonia*, *Veluticeps* and *Epithele* (sensu lato). We shall write only, about the last named genus, i.e. effused species with indeterminate margins. To gather all these effused species described nowadays in one genus would make this genus dissimilar, heterogeneous and unworthy. We propose to place in the genus *Vesiculomyces* Hagström (1977) emend., segregated from the genus *Gloeocystidiellum* Donk, the Malagasy *Vesiculomyces epitheloides* with amyloid spores and sulfoaldehyde positive gloeocystidia. We synonymise *Megalocystidium* (type *M. leucoxanthum* (Bres.) Jülich 1978) with *Vesiculomyces* (type *V. citrinus* (Pers.) Hagström), because these two genera contain some species of *Gloeocystidiellum* with smooth spores, with or without clamps, with gloeocystidia habitually exhibiting a positive sulfoaldehyde reaction (the gloeocystidia of *V. citrinus* react strongly in cultures, but appear empty in fructification). As a consequence some combinations are proposed.

The species with non-amyloid spores do not form a homogeneous group. Jülich (1976 and 1979) created successively several monospecific genera: *Epithelopsis*, *Pteridomyces* and *Skeletohydnum*. Their definitions are based on the cyanophily of the spores, their mono- or dimitism, and the size of the basidia. We have not collected species with cyanophilous spores (genus *Epithelopsis*), known only from New Zealand and Zaïre (Ryvarden 1978), but the size of the basidia, as well as the origin and development of a second hyphal system are progressive characters, and we wondered if the study of new species would not permit us to discover all kinds of intermediates. Our collections can be separated easily in two groups according to the size of basidia and the size of the spores: one group has narrow club-shaped basidia (narrower than 5 µm) and spores shorter than 8 µm; the other group has larger basidia, not club-shaped, and spores longer than 10 µm. But in these two groups, there are species without skeletal hyphae (monomitic) and species with skeletal hyphae more or less differentiated and more or less numerous. Table I shows the different localizations possible of the skeletal hyphae, -when they exist-, in the group with large spores: 1) only in pegs (should we call these species dimitic?), 2) in the pegs and in the context, 3) in the context only.

In the light of these facts it is necessary to either create several new genera with an absolute care for homogeneity (as it appears some people with probably a desire to leave their names to prosterity have done!) or accept, until a more complete knowledge of the epitheloid fungi of the world, that the kinds connected by the means of intermediates should be gathered again into a small number of less homogenous

genera. We agree with the second solution, and we include species with skeletal hyphae in the genus *Pteridomyces* emend., and we maintain all the large spored species, whatever their mitism should be, in the genus *Epithele*. We place also in the genus *Epithele* an unclamped species (*E. efibulata* sp. nov.). Three new African species of *Pteridomyces*, which are not growing on ferns, are proposed (*P. lacteus*, *roseolus*, *sphaericosporus*), and six new *Epithele* species (*E. citrispora*, *efibulata*, *guadelupensis*, *macarangae*, *malaiensis*, *ovalispora*). Four of these are African and most of them grow on palm-trees. Lastly, we described *Vesiculomyces epitheloides* from Madagascar.

We give cultural characters of seven species: *E. efibulata* is parthenogenetic without clamps. Such a species must not be placed in a different genus from the one with clamped species. *E. nikau* and *guadelupensis* are homothallic and clamped. *Vesiculomyces epitheloides* is heterothallic without clamps as are *V. citrinus* and *V. lactescens*.

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NEW SOUTH AMERICAN RESUPINATE POLYPORES[1]

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During a survey of the resupinate polypores in Argentina, two species pertaining to *Amylosporus* Ryv. and *Junghuhnia* Corda and a new variety of *Skeletocutis nivea* (Jungh.)Keller were found which are here described as new.

METHODS

Microscopic examinations of basidiocarps were made from freehand sections mounted in 5% KOH aqueous phloxine, in Melzer's reagent (Singer, 1949:80) and in 0,5% cotton blue in 25% lactophenol. Drawings were made with a camera lucida. Herbarium abbreviations are from Holmgren & Keuken (1974).

DESCRIPTION OF SPECIES

AMYLOSPORUS WRIGHTII sp. nov. (Fig. 1-5)

Basidiocarpus annuus vel perennis, late resupinatus, roseo-lilacinus, gossypinus vel suberosus, non xanthochrous, contextus vinaceus. Systema hypharum dimiticum. Hyphis generativis duorum typi: a)afibulatis tenuibus incrassatis, 2,1-10,5 µm diam.; b)septatus uni vel plurifibulatis verticillatisque, 5,2-10,4 µm diam., ramosis afibulatis. Hyphis skeletibus, 2,6-5,7 µm diam., parietis incrassatis hyalinis vel castaneis, dextrinoideis cyanophilisque. Hymenio basidiis afibulatis septiis basalis, claviformibus et brevi stipitatis, tetrasporis. Basidiosporis late ellipsoideis vel subglobosis, apiculatis, tenui asperulatis, 3,1-3,6 x 2,6 µm, amyloides, acyanophilis. Cystidiolis fusiformibus adsunt. Putrefactione ligno ignota.

Holotypus: Argentina, Misiones, Parque Nacional Cataratas del Iguazú, versus viam ad Apepú, leg. M.Rajchenberg M-3503, 4/III/1982, in herbario BAFC nº 28210 conservatus est.

A mycologo argentinensis J.E. Wright haec species dicata est.

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[1] This paper is part of a project on xylophilous Basidiomycetes subsidized by a grant from the Consejo Nacional de Investigaciones Científicas y Técnicas, Argentina. It is part of a thesis submitted to the University of Buenos Aires as partial fulfillment of the requirements for the degree of Doctor in Biology.

[2] Fellow of the above Consejo.

FRUITBODY annual to perennial, widely effused, easily separable from substratum and the annual layers from each other, 25 x 10 x 0,5 cm, cottony to corky. Margin wide, irregular, velvety. Pore surface lilaceous pink when fresh, turning cream or yellowish cream when dried. Pores 7-8 per mm. Context lilaceous when fresh, turning dark chestnut or vinaceous when dried; each layer up to 2 mm wide. Tubes short, up to 1 mm long. Alkali reaction negative with 5% KOH.

HYPHAL SYSTEM dimitic. Generative hyphae of two types: a) clampless, branched and thin walled hyphae, 2,1-10,4 µm wide, found in all the fruitbody (Fig. 2); and b) with one or multiple clamps, branched or not, 5,2-10,4 µm wide, with clampless and narrower branches, only found in the context (Fig. 3). Skeletal hyphae abundant, scantily to profusely branched, 2,6-5,7 µm wide, with thickened hyaline or chestnut walls, cyanophilous and variably dextrinoid in Melzer's reagent (Fig. 4). BASIDIA claviform to shortly pedicellate, 12,0-23,4 x 5,7-6,8 µm, tetraspored, not clamped at base (Fig. 5). BASIDIOSPORES broadly ellipsoid to subglobose, thin to slightly thick walled, minutely asperulated (when observed in Melzer's reagent, Fig. 5, and SEM, Fig. 1), amyloid, noncyanophilous, 3,1-3,6 x 2,6 µm. Fusiform cystidiols present; cystidia absent.

HABITAT: on unidentified angiosperms and associated with an unknown rot. DISTRIBUTION: in the subtropical rain forest of Misiones province.

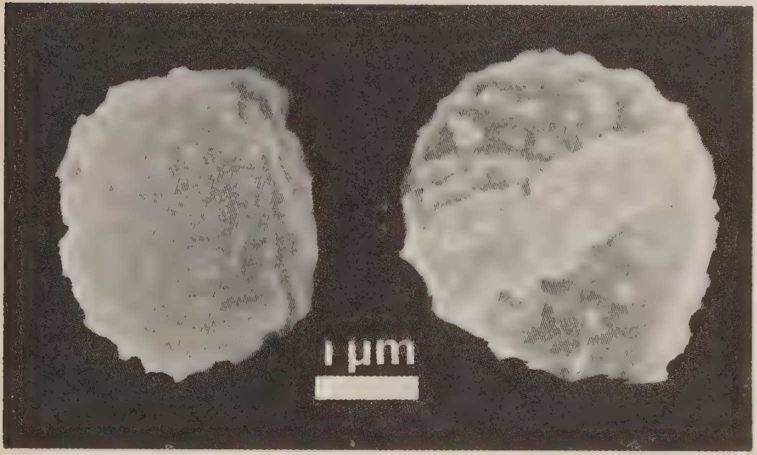
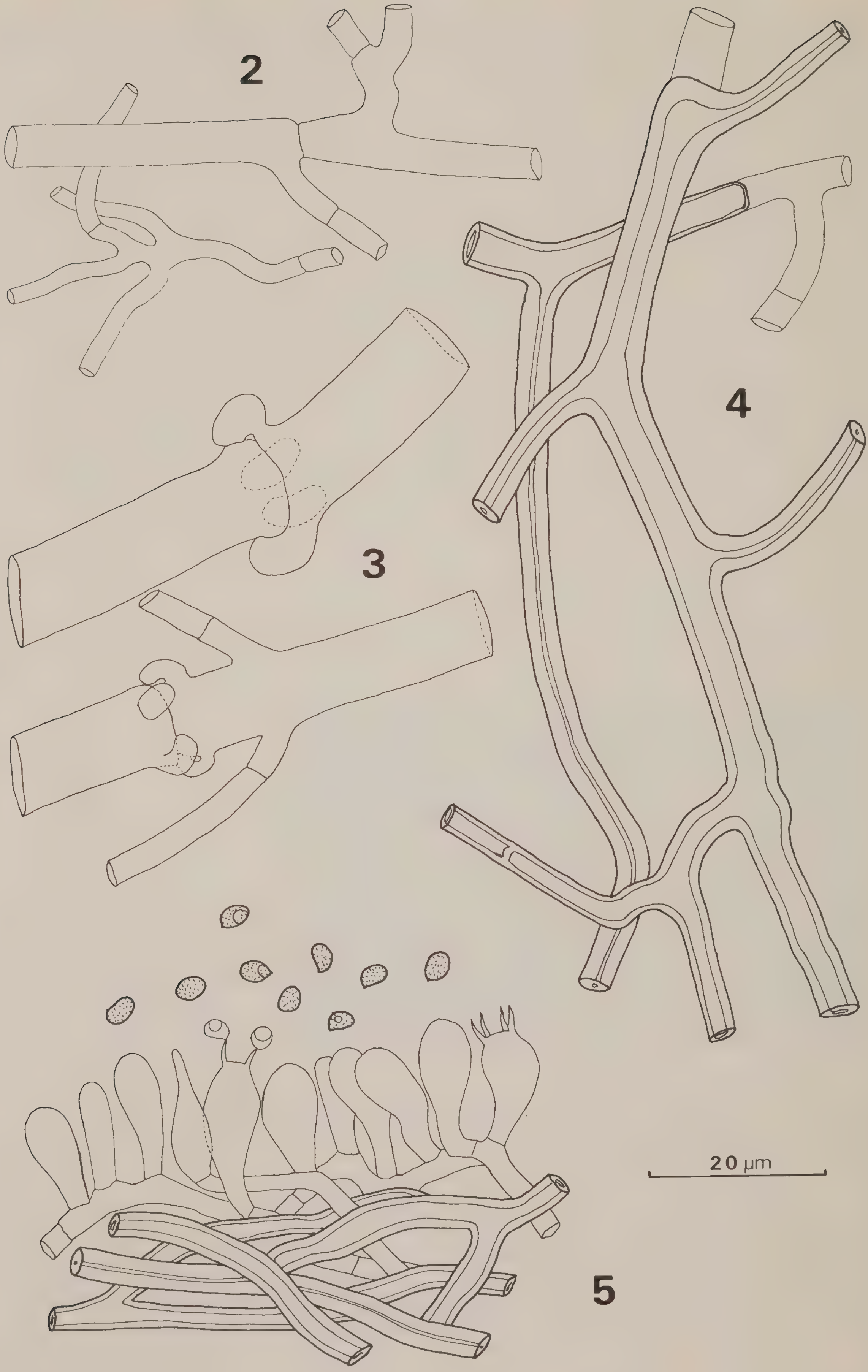


Fig. 1
SEM micrographs of basidiospores of *Amylosporus wrightii*

MATERIAL STUDIED: Argentina, Misiones, Colonia General Belgrano, Estación Forestal, leg. Wright, Deschamps and del Busto, 29/X/73 (BAFC 28211); Parque Nacional Cataratas del Iguazú, leg. M.Rajchenberg M-3503, 4/III/82 (BAFC 28210, holotype).

REMARKS: In spite of macromorphological differences with the type species of the genus *Amylosporus* Ryv., *Tyromyces graminicola* Murr. (=*Amylosporus campbelli* (Berk.)Ryv., fide Ryvarden, 1977:217) which is pileate and centrally or laterally stipitate, the peculiar hyphal system with two types of septation on the generative hyphae, the asperulated amyloid


20 µm

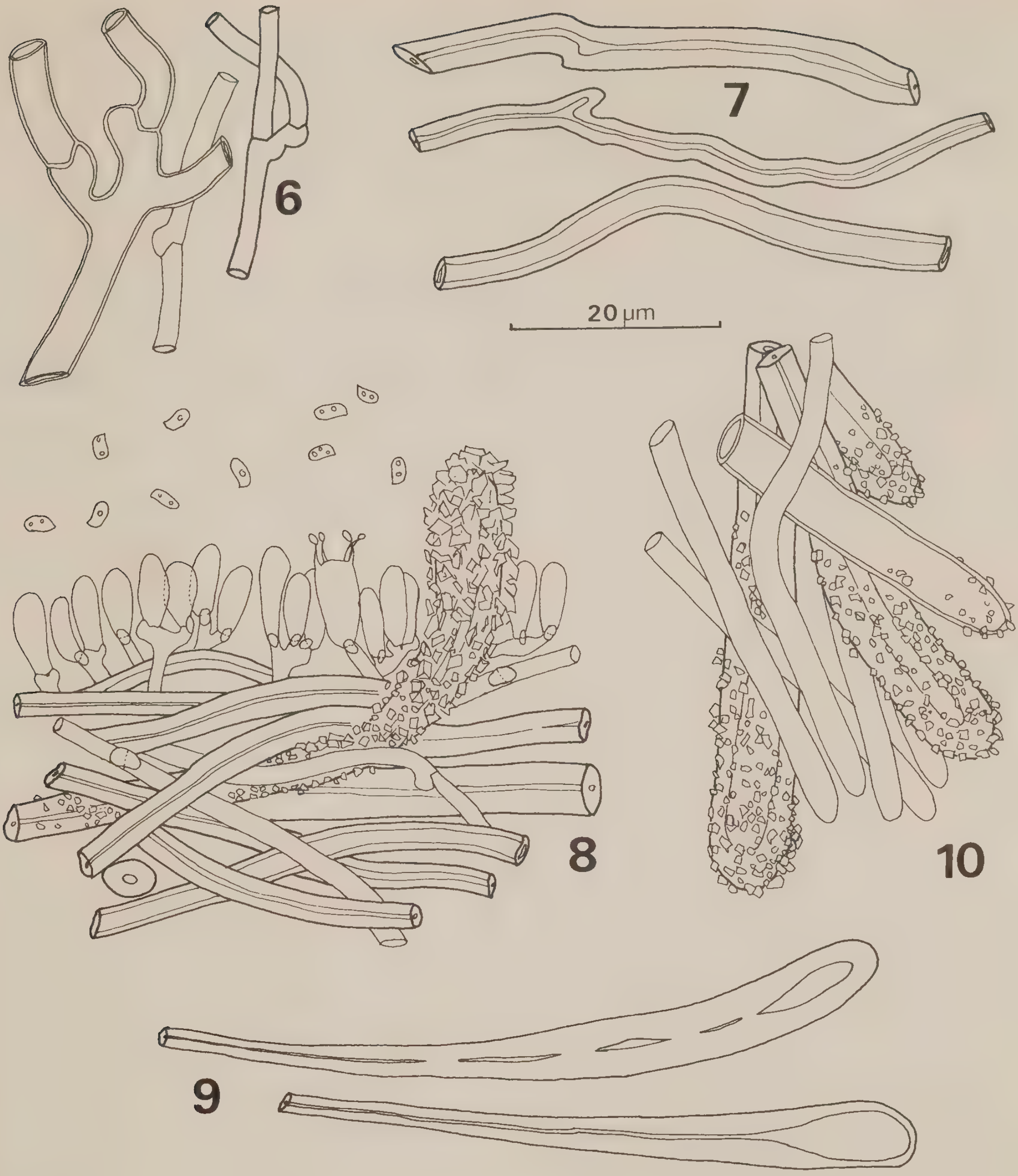


Fig. 2-5, *Amylosporus wrightii*: 2.simple septate generative hyphae; 3.simple and multiple clamped generative hyphae, unbranched or with simple septate branches; 4.skeletal hyphae; 5.hymenium and basidiospores.

Fig. 6-10, *Junghuhnia microspora*: 6.generative hyphae; 7.skeletal hyphae; 8.hymenium, cystidia and basidiospores; 9.cystidia (without crystals); 10.pore mouth with incrusted hyphae and cystidia.

spores and the pedicellate clampless basidia[3] point out to the congenerity of this new species with the latter. The skeletal hyphae with cyanophilous and variably dextrinoid walls relate this species to *Wrightoporia* Pouz. which differs in having generative hyphae and basidia with only simple clamped septa.

JUNGHUHNIA MICROSPORA sp. nov. (Fig. 6-10)

Basidiocarpus annuus, resupinatus, suberosus vel fibrillosus, cremeus, late castaneus vel fuscus, non xanthochrous; poris 5-7-(8) per mm. Systema hypharum dimiticum. Hyphis generativis fibulatis, 2,1-5,7 µm diam. Hyphis skeletibus 2,1-6,8 µm diam., parietibus incrassatis luteis. Hymenio cum basidiis claviformibus, tetrasporis. Basidiosporis ellipsoideis, hyalinis, apiculatis, parietibus angustis glabris, 2,6-3,6 x 1,0-1,6 µm, inamyloides, acyanophilis. Cystidiis incrustatis adsunt, copiosis extremitatibus disepimentiis. Putrefactione ligno alba.

Holotypus: Argentina, Misiones, Parque Nacional Cataratas del Iguazú, versus viam ad Apepú, leg. M.Rajchenberg 4/III/1982, in herbario BAFC nº 27993 conservatus est.

FRUITBODY annual, resupinate, totally attached to substrate, corky to fibrillose. Margin present or not, mycelial or velvety. Pore surface cream colour with light chestnut tints when fresh, turning beige, orange coloured or chestnut upon drying, and with the pore mouths remaining ash-coloured. Pores 5-7-(8) per mm, round to slightly angular. Context thin, cream coloured, up to 0,5 mm wide. Tubes up to 3 mm long. Alkali reaction negative with 5% KOH.

HYPHAL SYSTEM dimitic. Generative hyphae clamped, branched, hyaline, walls thin or slightly thickened, 2,1-5,7 µm wide (Fig. 6). Skeletal hyphae unbranched, thick-walled, 2,1-6,8 µm wide (Fig. 7). HYMENIUM 9,4-13,4 µm thick (Fig.8). BASIDIA claviform, 8,3-10,4 x 3,1-4,7 µm, tetraspored. BASIDIOSPORES ellipsoid, hyaline, thin-walled, 2,6-3,6 x 1,0-1,6 µm, inamyloid, acyanophilous. CYSTIDIA few to abundant, clavate (Fig. 9), 4,2-10,4 µm wide, thick-walled, embedded in the trama or projecting up to 30 µm, abundant in the pore mouths (Fig. 10), heavily incrusted apically, arising from skeletal hyphae.

HABITAT: on angiosperms, associated with a white rot. DISTRIBUTION: in the subtropical rain forest of Misiones province.

MATERIAL STUDIED: Argentina, Misiones, Parque Nacional Cataratas del Iguazú, leg. M.Rajchenberg 5/III/80 (BAFC 27992); ibid, leg. ipse 4/III/82, M-3504 (BAFC 27993, holotype), M-3510 (BAFC 27994) and M-3511 (BAFC 27995).

REMARKS: *Junghuhnia microspora* differs from other species of the genus by its small pores and spores. *J. collabens* (Fr.)Ryv. has a typical brick-red pore surface and larger allantoid to cylindric spores (3-5 x 1,2-1,7 µm). *J. nitida* (Pers.:Fr.)Ryv. differs in having larger ellipsoid spores (3,5-4,5 x 2,0-3,0 µm). *Poria novae-zelandiae* G.H. Cunn has similar pore and spore sizes, but skeletal hyphae are variably incrusted and never form true cystidia; besides, a slimy substance embeds all hyphal elements which is lacking in *Junghuhnia microspora*.

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[3] *Tyromyces graminicola* Murr. (holotype studied, NY) also lacks clamps at the base of the basidia in the fruitbodies. Gilbertson & Lowe (1970:704) in their study of this species do not give information on this feature, but illustrate simple clamped basidia produced in culture.

SKELETOCUTIS NIVEA (Jungh.)Keller var. *DILUTA* var. nov.

A typo differt hyphis skeletibus diffluentibus in 5% KOH et leviter amyloideis.

Holotypus: Argentina, Misiones, Iguazú, Puerto Esperanza, in satio Alto Paraná, leg. M.Rajchenberg III/1982, in herbario BAFC nº 28250 conservatus est.

FRUITBODIES and microscopical features are similar to those of the typical variety.[4] SKELETAL HYPHAE differ radically by dissolving in 5% KOH and in exhibiting a weakly amyloid reaction of their walls.

HABITAT: only found on *Pinus taeda* logs and other unknown gymnosperms, associated with a white rot. DISTRIBUTION: only found in subtropical implanted woods in Misiones province.

MATERIAL STUDIED: Argentina, Misiones, Iguazú, Puerto Esperanza, Alto Paraná plantation, leg. M.Rajchenberg III/1982 (BAFC 28250, holotype); ibid., leg. S.Blumenfeld 25/III/81 (BAFC 27657).

REMARKS: The remarkable character of this variety has only been known up to now in *Poria cinerascens* (Bres. ex Strass.)Sacc., a species that does not have an adequate generic disposition. Ryvarden (1976:82) placed it in *Antrodia* Karst. as *A. lindbladii* (Berk. & Br. ex Berk.)Ryv. (basionym:*Polyporus lindbladii* Berk. & Br. ex Berk.) but the type of wood-rot and cultural characters (Nobles, 1965:1132; Nakasone, 1981:108; and own unpublished data) show notable differences with those of *Antrodia* species (when compared with the table published by Domański, 1969:67). Whether the capacity of dissolving the walls in KOH solution may be a clue to relate *Poria cinerascens* with *Skeletocutis nivea* var. *diluta* is still a pending question, since *P. cinerascens* lacks typical incrustations present in *Skeletocutis* (=*Incrustoporia* Dom.) species (as shown by Keller, 1979:347). Besides, cultural features are different, as shown by a comparison of the principal code numbers (fide Nobles scheme, 1965:1103): 2. 4. 7. in *Poria cinerascens*, and 2. 3. (8). 9. in *Skeletocutis* species (David, 1971:95; Nobles, 1965:1129 and Stalpers, 1978:95). Notwithstanding this, there is a remarkable chemical correlation between presence of dissolving walls and amyloidity.

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[4] This striking reaction may be well observed by mounting the sections in phloxine solution and adding one drop of KOH solution while looking through the microscope. Walls evanesce, actually dissolve, and only a cellophane-like outer pellicle remains. The walls do not reconstitute when KOH solution is replaced overnight with phloxine solution.

ACKNOWLEDGMENTS

I wish to express my gratitude to Dr. M.J. Larsen (Madison) and Dr. L. Ryvarden (Oslo) for critically reading the M.S. and making invaluable suggestions. Particularly gratifying were the discussions held with the latter.

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COLLETOTRICHUM GLOEOSPORIOIDES (PENZIG) PENZIG ET SACCARDO

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The authorities for the anamorph of the common plant pathogen *Glomerella cingulata* (Stoneman) Spaulding et Schrenk have been variously, but incorrectly, cited. The correct nomenclature is:

Colletotrichum gloeosporioides (Penzig) Penzig et Saccardo, in Penzig, Note micologiche. III. Seconda contribuzione allo studio dei funghi agrumicoli. *Atti del Reale Istituto Veneto di Scienze, Lettere ed Arti, Serie 6, 2*(5): 670. 1884.

Basionym: *Vermicularia gloeosporioides* Penzig, Funghi agrumicoli. Contribuzione allo studio dei funghi parassiti degli agrumi. *Michelia 2*: 450. 1882.

Penzig employed the combination 9 times in his 1884 paper, but only 2 of these occurrences refer to a previously published description as required for valid publication of a new combination (International Code of Botanical Nomenclature, 1978, Article 32). The first of these, on p. 670 under "*Colletotrichum gloeosporioides* Penz. et Sacc.", not only indicates the basionym but also includes a taxonomic discussion and a redescription of the species.

Penzig's 1882 paper was also distributed as a separatum with its own pagination (see Lindau & Sydow, 1909, item 20412), so that the basionym has been cited as published in "Fung. agr., p. 66" (e.g. by Penzig, 1884, p. 671). Penzig's 1884 paper may also have been distributed as a separatum; this would account for Saccardo's (1884, p. 735) citation of the new combination as published in "F. Agrum. II. p. 6." Arx (1957a, p. 427) also cites the publication in this way, but assigns incorrect dates to both the basionym and the new combination. [Arx's annotation "teste Shear et Wood, 1913" does not assist, since Shear & Wood (1913, pp. 27, 104) refer only to Penzig's 1882 paper.] These errors have been perpetuated by Arx (1957b, p. 38; 1970, p. 59) and Sutton (1980, p. 530). The correct dates of Penzig's two papers are defined by the journal title pages and the author's prefaces ("1 Decembr. 1882" - "Giugno 1882"; and "dal Novembre 1883 all' Ottobre 1884" - "Gennajo 1884", respectively).

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ECTOMYCORRHIZAE OF SELECTED CONIFERS GROWING IN SITES WHICH SUPPORT DENSE GROWTH OF BRACKEN FERN

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SUMMARY

Fifteen ectomycorrhizae are described for *Abies concolor* of which the mycobiont is known for six and thirteen ectomycorrhizae are described for *Pseudotsuga menziesii*, of which three mycobionts were identified. The presence of these mycorrhizae on conifer seedlings located in sites overgrown by bracken fern suggests that the phytotoxins of bracken fern have little effect on ectomycorrhizae formation in nature in these areas.

INTRODUCTION

Many acres of formerly forested land in the Pacific Northwest now support dense growth of bracken fern, *Pteridium aquilinum* (L.) Kuhn (Isaac, 1940). One of the reasons bracken fern can dominate vegetation is its ability to produce allelopathic chemicals (Glass, 1976; Gliessman, 1976; Gliessman and Muller, 1972).

Bracken fern produces four phytotoxic phenolic acids: p-hydroxybenzoic acid, vanillic acid, ferulic acid, and p-hydroxycinnamic acid (Glass, 1976; Glass and Bohm, 1969). Small amounts of the toxins can be found in the rhizome but the highest concentrations are found in the fronds (Gliessman and Muller, 1972). Each fall, the current year's growth of fronds die and the toxins are released by rainfall into the soil as free phenolic acids (Glass, 1976; Whitehead, 1964). Whitehead (ibid) found that in sandy soil under bracken fern the four phenolic acids were present in the following concentrations: p-hydroxybenzoic acid, 3.9×10^{-5} M; vanillic acid, 4.9×10^{-5} M; ferulic acid, 0.4×10^{-5} M; and p-hydroxycinnamic acid, 4.2×10^{-5} M. Once in the soil they can be absorbed from the soil solution by plant roots (Glass, 1976; Gliessman and Muller, 1972).

Gliessman and Muller (1972) discovered that radicle growth of *Bromus rigida* Roth. is inhibited by water extracts of the fern fronds. They also found that shoot growth of *Avena fatua* L. is inhibited when the plants are grown in soil containing crumbled fronds. In another experiment, the four phenolic acids, in concentrations similar to those found in the soil by Whitehead (1964), were added to hydroponically grown barley, *Hordeum vulgare* L.C.V. Carlsberg & C.V. Zephyr, resulting in an overall decrease in root volume (Glass, 1976).

Ectomycorrhizae benefit their plant associates in many ways. The fungal partner of the association can increase the nutritional uptake of the plant by expanding the volume of soil the plant can exploit (Bowen, 1973; Harley, 1959). Another benefit of the mycorrhizal association for the tree is protection of the root against toxic chemicals. Mycorrhizae are considered essential in the revegetation of soil containing residual heavy metals from anthracite mining (Schramm, 1966). Toxins in bituminous mining spoils either did not affect, or increased, the growth of trees with mycorrhizae (Medve et al., 1977). The herbicides, 2,4-D, 2,4,5,-T, and amitrole, and the pesticide malathion do not affect growth of mycorrhizal fungi in culture (Dasilva et al., 1977). Simazine, a weed control herbicide, does not affect mycorrhizal development on *Pinus* seedlings (Smith and Ferry, 1979). Ectomycorrhizae also protect their associates against effects of air pollution. Carney et al. (1978) demonstrated that loblolly pine (*Pinue taeda* L.) with ectomycorrhizae were more resistant to the effects of sulfur dioxide and ozone than those seedlings without mycorrhizae.

Because mycorrhizae are known to increase the volume of soil exploited by a plant and because they are able to tolerate certain toxic effects, some mycorrhizae may enable conifer seedlings to survive among bracken fern. This project describes an attempt to explore the hypothesis that fungi form ectomycorrhizae with conifer seedlings on sites on which bracken fern are growing, and that these ectomycorrhizae protect seedlings against effects of the fern phytotoxins.

MATERIALS AND METHODS

Five sites in Humboldt County, California, were selected on the basis of presence of bracken fern and conifer seedlings and differences in elevation, slope aspect, parent material, and conifer species (Table I). A comparison of the features of the five sites shows a variation in elevation from 880 to 1370 meters, and a great diversity in slope aspects. There were three parent material types on the sites. Two were igneous in origin; the peridiotite-gabbro complex of sites I and II and the diorite-monorite-granite combination of site V. On sites I and II there is an additional component, serpentine outcrops. The third parent type, sandstone and shale on sites III and IV are sedimentary in origin. The vegetation of all five sites included *Pseudotsuga menziesii* (Mirb.) Franco. but differ in associated tree species. *Abies concolor* (Gord. & Glend.) Lindl. is an additional component on sites I, II and IV, *Pinus ponderosa* Laws. is found on sites II and IV, and *Libocedrus deurrens* is on sites I and II.

Mycorrhizal roots were collected from May to December 1979, and subsequently described in the laboratory. Descriptions were based on characters of the mantle, Hartig net, attached rhizomorphs, attached mycelium, and the rootlet. Mycorrhizae that were very similar in a number of characters were combined. Some of the fungal partners are taxonomically unknown because there were no fruiting bodies found in contact with those roots. Although no sclerotia of *Cenococcum graniforme* (Sow.) Ferd. & Winge were found, it was identified by its characteristic appearance of jet black mycelium. Voucher specimens of the roots are located in the Humboldt State University Cryptogamic Herbarium and stored in vials of 50:50 (v:v) mixture of Craf 3 solution (9:1, v:v, chromium trioxide: glacial acetic acid) and 20% formalin.

In both the spring and fall of 1979, fruiting bodies of fungal species were collected from the sites. Three criteria were used to determine mycorrhizal associations. One, as each fruiting body was found it was examined to determine if there was physical contact with or a close proximity to mycorrhizal roots. Two, macroscopic and microscopic features of the hyphae at the sporocarp base were compared to features of the hyphae attached to the mycorrhiza. Three, the literature was reviewed for reports of a mycorrhizal association between the fungal species and the conifer species. The sporocarps were dried and stored as voucher specimens.

Table I. Field Site Descriptions

Site Number	Elevation (meters)	Slope Aspect	Parent Material[a]	Conifer[b] Species
I	1370	N to E	peridiotite, gabbro, serpentine	PM, AC, LD
II	1280	W to NE	peridiotite, gabbro, serpentine	PM, AC, LD, PP
III	1010	NE to ESE	sandstone, shale	PM
IV	880	NE to SE	sandstone, shale	PM, PP
V	1280	E to SW	granodiorite, quartz diorite, quartz monorite, granite	PM, AC

[a] Jennings, Strand, and Rogers, 1977

[b] PM= *Pseudotsuga menziesii*, AC = *Abies concolor*, PP = *Pinus ponderosa*, LD = *Libocedrus decurrens*

Table II. Ectomycorrhizae associated with *Abies concolor*.

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
Hysterangium separabile Zeller (physical contact)	20-200 μm diam, ropy-wefty, white, glabrous + clamp c.	hyaline, rough-walled, - clamp c, gossamer net	white, glabrous 18-55 μm, - clamp c, prosenchyma	1-2 hyphae wide between cortical cells	.4-.8 mm diam, monopodal-open pinnate

Note: +c = clamp connections present
-c = clamp connections absent

On each site one or two root samples consisting of sixty to one hundred rootlet tips from each of twenty randomly selected seedlings were collected. Samples were collected from seedlings of *Abies concolor, Pseudotsuga menziesii,* and *Pinus ponderosa*. Each tip was examined and the percentage of all tips that were mycorrhizal was calculated. Tips were considered to be mycorrhizal if they were swollen, had no root hairs, were shortened, and had visible signs of hyphae on the rootlet surface. Questionable mycorrhizal roots were dissected and examined under a microscope.

RESULTS AND DISCUSSION

Examination of root samples from the field sites showed that over 90% of the roots had mycorrhizal infections on all sites. The average infection of the root samples from each site was as follows: site I, 99.7%; site II, 99.1%; site III, 98.1%; site IV, 99.4%; and site V, 91.4%.

All mycorrhizae described were ectomycorrhizae associated with either *Abies concolor* or *Pseudotsuga menziesii*. Except for *Cenococcum graniforme*, the fungal associates of *Abies concolor* mycorrhizae displayed different characteristics from those of *Pseudotsuga menziesii* mycorrhizae. A variety of mycorrhizal types found on the field sites exhibited differences in rhizomorphs, mycelium attached to the mantle, the mantle, the Hartig net and the rootlets. When compared, rhizomorphs differed in form, either ropy or ropy-wefty, in color, from white to yellow, and in diameter. In all specimens examined, the mycelium attached to the mantle consisted of hyaline hyphae that had either rough or smooth walls and was 1.5 to 4 μm in diameter. Characteristics of the mantle varied greatly in color and texture. The mantle of all but two of the types examined consisted of parenchymatous hyphae. Of the mantles made of synenchymatous hyphae, the mycobiont of one was *Cenococcum graniforme*, the other was unknown. The Hartig nets analyzed were composed of one to several hyphae between the cells of the root cortex and extended to the endodermis or to one cell layer from the endodermis. Rootlets examined were shortened and swollen but differed from one another in branching patterns, from monopodal to pinnate, remiform or tuberculate (Tables II & III).

The variety of mycorrhizal forms and mycorrhizal infection of over ninety percent on all sites indicate that formation of mycorrhizae by some fungi on the rootlets of *Abies concolor* and *Pseudotsuga menziesii* is not inhibited by the phytotoxins produced by bracken fern.

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Table II. Ectomycorrhizae associated with *Abies concolor* (cont.)

Fungal Species	**Rhizomorphs**	**Mycelium**	**Mantle**	**Hartig Net**	**Rootlets**
Rhizopogon subsalmonius Smith	90-150 μm diam, ropy, white, glabrous, - clamp c	none	white, cottony over metallic blue, glabrous, 34-39 μm, clamp c, prosenchyma	1-2 hyphae wide	ramiform
Rhizopogon parksii Smith (physical contact)	62-135μm diam, ropy-wefty, white, glabrous, - clamp c.	hyaline, rough-walled, + clamp c, 2-2.5 μm	white, cottony, 6-30 μm, + clamp c, prosenchyma	3-4 hyphae wide	.3-.5 (.6) mm diam, open pinnate-ramiform
Rhizopogon colossus Smith	none	none	white, reticulate, 18-60 μm, prosenchyma	2-3 hyphae wide	.4-.6 mm diam, open pinnate
Lactarius deliciosus (Fr.) S.F. Gray	none	none	metallic green and gray, glabrous, 32-46 μm, - clamp c, prosenchyma	2-3 hyphae wide	.5-.8 mm diam, open pinnate
Cenococcum graniforme (Sow.) Ferd. & Winge	none	none	black, crusty-bristly, 10-58 μm, - clamp c, synenchyma	1-3 hyphae wide	.3-.6 (-.7) mm diam, monopodal-ramiform
unknown	none	none	metallic silver, glabrous, 31-46 μm, prosenchyma	2-3 hyphae wide	.5-.6 mm diam, closed pinnate-tuberculate

Table II. Ectomycorrhizae associated with *Abies concolor* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
unknown	none	hyaline, 4 μm smooth-walled + clamp c, thick net	white, granular, 10-13 μm, + clamp c, prosenchyma	2-3 hyphae wide	.3-.4 mm diam, open pinnate
unknown	95-200 μm diam, ropy, yellow, glabrous, + clamp c	hyaline, smooth-walled 2-3 μm, + clamp c, gosamer net	yellow, cottony, 10-19 μm, prosenchyma	3-4 hyphae wide	.5-.6 mm diam, tuberculate
unknown	none	none	lavender, bristly, 34-50 μm, prosenchyma	1-2 hyphae wide	.3-.4 mm diam, coralloid
unknown	150-300 μm diam, ropy, pale yellow, glabrous, - clamp c	hyaline rough-walled, 1-4 μm, + clamp c, wefty	pale yellow, cottony, 16-65 μm, prosenchyma	2-3 hyphae wide	.3-.6 mm diam, monopodal-open pinnate
unknown	none	none	gold-pink, glabrous, 13 μm, prosenchyma	2-3 hyphae wide	.5-.6 mm diam, monopodal-ramiform
unknown	none	hyaline, rough-walled, 2-3 μm, + clamp c, gossamer net	blue, granular, 15-25 μm, prosenchyma	2-4 hyphae wide	.2-.4 mm diam, closed pinnate

Table II. Ectomycorrhizae associated with *Abies concolor* (cont.)

Fungal Species	**Rhizomorphs**	**Mycelium**	**Mantle**	**Hartig Net**	**Rootlets**
unknown	none	none	metallic gray brown, glabrous, 31-52 μm, + clamp c, prosenchyma	3-5 hyphae wide	.3-.6 mm diam, monopodal-open pinnate-ramiform
unknown	none	none	brownish red to black, glabrous-crusty, 10-26 μm, - clamp c. prosenchyma	2-4 hyphae wide	.4-.5 mm diam, monopodal

Table III. Ectomycorrhizae of *Pseudotsuga menziesii*

Fungal Species	**Rhizomorphs**	**Mycelium**	**Mantle**	**Hartig Net**	**Rootlets**
Hebeloma crustiliniforme (Bull. & Saint-Aman) Quel.	none	none	white over yellow brown, cottony, 10-18 μm, + clamp c, prosenchyma	1-2 hyphae wide	.2-.3 mm diam, open pinnate
Rhizopogon villosulus Zeller (physical contact)	10-57 μm diam, ropy, salmon, cottony, + clamp c	hyaline, smooth-walled 1.5-2.5 μm, + clamp c	metallic white-salmon, cottony, 28-51 μm, + clamp c, prosenchyma	2-3 hyphae wide	.4 mm diam, closed pinnate

Note: +c = clamp connections present
-c = clamp connections absent

Table III. Ectomycorrhizae of *Pseudotsuga menziesii* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
Cenococcum graniforme (Sow.) Ferd. & Winge	none	none	black, crusty granular 6-35 (-180) μm, - clamp c, synenchyma	3-5 hyphae wide	.3-.5 (-.8) mm diam, monopodal-ramiform
unknown	80 μm diam, ropy, white, glabrous	hyaline, smooth-walled 2.6 μm, + clamp c, gossamer net	white, glabrous, 19-22 μm, + clamp c, prosenchyma	2-3 hyphae wide	.3-.5 mm diam, dichotomous-pinnate
unknown	none	none	white over black, reticulate, 14-50 μm, prosenchyma	2-3 hyphae wide	.5-.6 mm diam, monopodal-open pinnate
unknown	13-26 μm diam, ropy, white, glabrous, + clamp c	hyaline, rough-walled, 2-3 μm, + clamp c, gossamer net	white over tan, granular over glabrous, 13-44 μm, prosenchyma	4-5 hyphae wide	.3-.4 mm diam, open pinnate
unknown	none	none	pinkish brown, granular, 16-65 μm, prosenchyma	4-5 hyphae wide	.5-.8 mm diam, ramiform

Table III. Ectomycorrhizae of *Pseudotsuga menziesii* (cont.)

Fungal Species	Rhizomorphs	Mycelium	Mantle	Hartig Net	Rootlets
unknown	71 μm diam, ropy, yellow brown, glabrous	hyaline, smooth-walled 2-3 μm, + clamp c, net	gold tan with lavender mottles, glabrous, 31-39 μm, synenchyma, scattered bristles	2-3 hyphae wide	.4-.6 mm diam, monopodal
unknown	none	none	blue gray over golden brown, glabrous, 26-52 μm, prosenchyma	3-4 hyphae wide	.3-.5 mm diam, closed pinnate-ramiform
unknown	none	hyaline, smooth-walled 2-4 μm, + clamp c, cottony	blue, cottony, 13-29 μm, prosenchyma	3-4 hyphae wide	.3-.5 mm diam, open pinnate-ramiform
unknown	none	none	pink brown-red brown, bristly, 30-34 μm, prosenchyma	2-4 hyphae wide	.5-.6 mm diam, open pinnate-ramiform
unknown	none	none	tan, glabrous, 20-52 μm, prosenchyma	3-4 hyphae wide	.3-.4 mm diam, open pyramidal-ramiform
unknown	none	none	gold brown-dark brown, 19-22 μm, prosenchyma	3-5 hyphae wide	.2-.5 mm diam, monopodal

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MYCORRHIZAE OF *ARBUTUS MENZIESII* PURSH. AND *ARCTOSTAPHYLOS MANZANITA* PARRY IN NORTHERN CALIFORNIA

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SUMMARY

51 arbutoid-, 2 arbutoid-ericoid- and 7 ecto-mycorrhizae are described as occurring on roots of either *Arbutus menziesii* Pursh. or *Arctostaphylos manzanita* Parry in 3 different sites in northern California. All sites consisted of a predominance of *Arctostaphylos manzanita* with scattered trees of two conifers, *Pinus ponderosa* Laws. and *Pseudotsuga menziesii* (Mirb.) Franco.

INTRODUCTION

Arbutus menziesii Pursh. and *Arctostaphylos* species growing in the shrublands and woodlands of Northern California commonly form mycorrhizae (Largent et al., 1980b). However, little research attention has been focused on the description of thee mycorrhizae or identification of the fungal symbiont. Several pure culture synthesis studies have established that various fungi which are known to form ectomycorrhizae with conifers can also form arbutoid mycorrhizae with *Arbutus menziesii*, *Arctostaphylos uva-ursi* (L.) Spring., and *Arctostaphylos manzanita* Parry (Comes, 1980; Molina and Trappe, 1982; Zak, 1976a, 1976b). While there is no certainty that these mycorrhizae will form under natural conditions, it demonstrates the variety of fungal species which are potential mycorrhizal formers with these plants. By tracing the rhizomorphs and mycelia between sporocarps and mycorrhizae on root samples collected in field work, three fungal symbionts have been identified: *Cortinarius aureifolius* Peck var. *hesperius* J.F. Ammirati in association with *Arctostaphylos uva-ursi* (Zak, 1973); *Cortinarius zakii* J.F. Ammirati with *Arbutus menziesii* (Zak, 1974); and *Amanita gemmata* (Fr.) Gill. with *Arctostaphylos manzanita* (Largent, et al., 1980a). A fourth fungus, *Cenococcum graniforme* (Sow.) Ferd. & Winge, identified by the appearance of the mycorrhizae, associates with *Arbutus menziesii* and several *Arctostaphylos* spp. (Largent et al., 1980b; Trappe, 1964; Zak, 1973, 1974).

The mycorrhizae formed with *Arctostaphylos* spp. and *Arbutus* spp. are predominantly arbutoid, but ericoid forms and ectomycorrhizae have also been observed (Largent et al., 1980b; Mejstrik and Hadac, 1975; Trappe, 1964; Zak, 1973, 1974). The type of mycorrhizae formed by *Cenococcum graniforme* has been placed in more than one category. Field studies show that this fungus is capable of forming ectomycorrhizae with *Arc-*

tostaphylos and *Arbutus* (Largent et al., 1980b, Mejstrik and Hadac, 1975), while in pure culture experiments it develops into an arbutoid type (Molina and Trappe, 1982; Zak, 1976a, 1976b).

Because little field work has been done on the mycorrhizae of *Arctostaphylos* spp. and *Arbutus* spp. this study was undertaken to provide more complete information on the characteristics of their mycorrhizae and to identify some of their natural fungal symbionts.

MATERIALS AND METHODS

Root specimens were collected from *Arbutus menziesii* and *Arctostaphylos manzanita* on three sites in Humboldt County, California, from 1979 to 1981. The predominant vegetation on the sites is *Arctostaphylos manzanita*, with scattered *Arbutus menziesii*, *Pinus ponderosa* Laws., and *Pseudotsuga menziesii* (Mirb.) Franco. One of the sites also has *Quercus garryana* Dougl. and *Quercus chryolepis* Liebm.

The roots were examined both macroscopically and microscopically and described using features of the mantle, attached mycelium, attached rhizomorphs, and the rootlets. The root specimens examined are stored in Craf #3 solution at Humboldt State University, Arcata, California.

Sporocarps of fungi associated with the mycorrhizae were also collected whenever observed. Fungal species were determined to be mycorrhizal symbionts if the sporocarps were in physical contact with or repeated close proximity to mycorrhizal roots, and the features of the mycelium or rhizomorphs at the sporocarp base were identical to those of the mycorrhizal root. The sporocarps were dried and are stored as voucher specimens in the Humboldt State University fungal herbarium.

RESULTS

Mycorrhizae were found on all but one of the root samples collected. Repeatedly, a number of different mycelial and rhizomorph types were noticed in the soil, concentrating in the area surrounding a rootlet complex. Root samples often had up to five different mycorrhizae on a 10-20 cm length of root.

Fifty-five mycorrhizae were described in association with *Arctostaphylos manzanita* and five with *Arbutus menziesii*. Most of the mycorrhizae examined, including *Cenococcum graniforme*, were arbutoid (Tables I-IV). Anatomically, these mycorrhizae were all very similar, with well developed mantles, a Hartig net extending between cells of the outermost layer of cortical cells, and intracellular hyphae packed into the cells of the first layer of the cortex. The morphology of the specimens was highly variable, differing in the structure, texture and color of the mantle, attached mycelium and rhizomorphs, and the branching forms of the rootlet complexes. A second type of mycorrhiza examined was intermediate between ericoid and arbutoid forms (Table V). These roots exhibited a thin mantle with a weak or nonexistent Hartig net, intracellular hyphae in the cells of the first one to two layers of cortical cells, and typical arbutoid swelling and branching patterns of the rootlets. Roots determined to be ectomycorrhizal differed from the arbutoid types only in the absence of intracellular hyphae (Table VI). The Hartig net, unlike those found in ectomycorrhizal conifer roots, extended only between the outermost one or two layers of cortical cells.

Several fungi were identified as mycorrhizal associates of *Arctostaphylos manzanita*. Species of *Cortinarius* were most common: *Cortinarius zakii*, *Cortinarius fibrillosipes* var. *fibrillosipes* J.F. Ammirati, and two unidentified species. A species of *Calocybe* and *Boletus aereus* Bull. ex Fr. were also identified. *Cenococcum graniforme*, identified by the characteristics of the mycorrhizae and the presence of black sclerotia, was found in association with both *Arbutus menziesii* and *Arctostaphylos manzanita*. *Lyophyllum* sp. was the only other fungus identified in an association with *Arbutus menziesii*.

Table I. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with known fungal symbionts.

Fungal Species	Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
Calocybe sp. JA-319 (physical contact)	cream yellow; glabrous; < 10 μm diam; prosenchymatous; hyphae—thin, punctate walls, 2.5-3 μm diam.	hyaline; thin/thick, punctate walls; 2-3 μm diam; -c; gossamer	cream; 10-150 μm; spreading ropy; glabrous; hyphae—thick, punctate walls, 3-5 μm diam, common branching	trilobate; .17-.21 mm diam.	M30B
Cortinarius sp. JA-338 (physical contact)	white; wefty; 5-11 (-18) μm diam; prosenchymatous; hyphae—smooth walls, 2 μm diam.	hyaline; thick, smooth walls; 2-2.5 μm diam; +c; common branching; gossamer	white; 36-120 μm; spreading ropy; glabrous; hyphae—thick, smooth walls, 2-3.5 μm diam, +c	monopodal/ramiform; .20-.24 mm diam.	M16B
Cortinarius sp. JA-300 (physical contact)	white/golden brown; reticulate; 19-40 μm diam; prosenchymatous; hyphae—thick, smooth walls, 2.5-4 μm diam, +c	hyaline; thick, smooth walls; 2.5-3.5 μm diam; +c; common branching; wefty/cottony	white; 25-130 μm; spreading ropy/wefty; glabrous	bilobate; .16-.56 mm diam.	M05 M08

Note: +c = clamp connections present
-c = clamp connections absent

Table I. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with known fungal symbionts. (cont.)

Fungal Species	Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
Cortinarius zakii cf. JA-316 (physical contact)	golden brown; wefty; 10-25 μm diam; prosenchymatous; hyphae—thin smooth walls, 3-4 μm, +c	hyaline; thick, smooth walls; 2.5-3.5 μm diam; +c; common branching; wefty	absent	monopodal/ ramiform; .21-.27	M28
Cortinarius fibrillosipes var. *fibrillosipes* AB-021 (physical contact)	yellow; wefty; 13-26 μm diam; prosenchymatous	hyaline; peglike/ coralloid wall incrustations; 2.5-4 μm diam; +c; wefty	light yellow; 58-59 μm diam; long, threadlike	pinnate; .28 mm diam.	AB021
Boletus aereus AB-016 (physical contact)	white/golden brown; cottony; 13 μm diam; prosenchymatous; aculeate setae, 52 μm long, septate base	hyaline; 2.5 μm diam; +c; common branching; pseudoclamps; wefty	absent	closed pinnate	AB016
Cenococcum graniforme (mycorrhizae characters)	black; bristly 10-33 μm diam; synenchymatous; hyphae—dark, thick, smooth walls	black; thick, smooth walls, 3.5-6 μm diam; -c; infrequent branching; bristly	absent	monopodal/ trilobate; .18-.32 mm diam.	M26A M35A M13C M32A M30A

Table II. Arbutoid mycorrhizae of *Arbutus menziesii* with known fungal symbionts.

Fungal Species	**Mantle**	**Attached Mycelium**	**Rhizomorphs**	**Rootlet**	**Root Specimens**
Lyophyllum sp. JA-332, JA-333 (root proximity)	gray; cottony; 17-30 μm diam; prosenchymatous; hyphae—thick, smooth walls, 2-3 (-5) μm diam, + c	hyaline; thick, smooth walls; 2.5-4 (-5.5) μm diam; + c; common branching; anastomosing; cottony	absent	monopodal/ ramiform; .21-.29 mm diam.	M33 M34
Cenococcum graniforme (mycorrhizae characters)	black; bristly; 8-28 μm diam; synenchymatous; hyphae—thick, smooth walls, 3-5 μm diam, -c	black; thick, smooth walls; 5 μm diam; -c; infrequent branching; bristly	absent	monopodal/ trilobate; .24-.32 mm diam.	M29A

Note: +c = clamp connections present
-c = clamp connections absent

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
translucent white; glabrous; 15-27 μm diam; prosenchymatous; hyphae—smooth walls, 2-2.5 μ diam, -c	hyaline; smooth/ punctate walls; 2-2.5 μm diam; +c; infrequent branching; sparse, singly attached to mantle	absent	bilobate; .25-.36 mm diam.	M02A
white; glabrous; 15-20 μm diam; prosenchymatous; hyphae—smooth walls, 3-5 μm diam.	hyaline; thin, smooth walls; 2-3 μm diam; cottony	absent	trilobate; .24-.49 mm diam.	M15A
white; granular; 15-30 μm diam; prosenchymatous; hyphae—outer layer twisted, 2.5-3.0 μm diam; inner layer rectangular 2 μm x 2.5-6 μm	absent	absent	monopodal/ trilobate; .18-.25 mm diam.	M17A
white; woolly; 10-18 μm diam; prosenchymatous; hyphae—thin, smooth walls, -c	hyaline; thin, smooth/ rough walls; 1.5 μm diam; +c; sparse, singly attached to mantle	absent	bilobate/ trilobate; .24-.28 mm diam.	AB026
white; reticulate; 6-12 μm diam; prosenchymatous	absent	absent	trilobate; .18-.27 mm diam.	M03

Note: +c = clamp connections present
-c = clamp connections absent

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
white; reticulate/cottony; 15-35 μm diam; prosenchymatous; hyphae—smooth walls, -c	hyaline; thick, smooth walls; 3-4 μm diam; +c; cottony	white; 26-40 μm diam; spreading ropy; glabrous	ramiform; .25-.33 mm diam.	M10
white; reticulate/cottony; 15-40 μm diam; prosenchymatous; hyphae—thin, smooth walls, -c	hyaline; thin, smooth walls; 2.5-3.5 (-4.5) μm diam; +c; common branching; cottony	absent	ramiform; .24-.36 (-.49) mm diam.	M12
white; cottony; 9-20 μm diam; prosenchymatous	hyaline; thick, smooth walls; 2.5-4 μm diam; +c; common branching; wefty	absent	ramiform; .15-.20 mm diam.	M01A
white; cottony; 15-25 μm diam; prosenchymatous; hyphae—smooth walls, 4-5 μm diam, -c	hyaline; thin punctate walls; 2.5-3 μm diam; +c; cottony	absent	monopodal/bilobate; .18-.26 mm diam.	M09
white/gray tinges; wefty/cottony; 10-15 μm diam; prosenchymatous; hyphae—thin smooth walls, 2-2.5 μm diam, -c	hyaline; thin, smooth walls; 2-3 μm diam; +c; common branching; gossamer	white; 12-64 μm diam; wefty/ropy; cottony	trilobate; .21-.26 mm diam.	M40

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
white/yellow tinges; reticulate/cottony; 6.5-19 μm diam; prosenchymatous; hyphae—rough walls, 2-3 μm diam; +c	hyaline; smooth walls; 2.5-3 μm diam; +c; infrequent branching; gossamer	white; 6.5 μm diam; threadlike	trilobate; .21-.52 mm diam.	AB022
white/tan; glabrous; 12-30 μm diam; prosenchymatous; hyphae—2-4 μm diam, -c	hyaline; thin, smooth walls; 2-4 μm diam; +c; sparse gossamer	absent	trilobate; .15-.28 mm diam.	M19A M26B M38
white/reddish brown/black; cottony; 19-35 μm diam; synenchymatous; hyphae—peglike incrustations	hyaline; smooth walls; 2.5 μm diam; +c; gossamer/cottony	tan/gray; 100 μm diam; threadlike; wefty	trilobate	AB018
white/blackish cast; fleecy; 20-31 μm diam; synenchymatous	hyaline; coralloid wall incrustations; 3-6.5 μm diam; -c; fine wefty	absent	bilobate/trilobate;	AB005
cream/dark yellow; wefty; 4-10 μm diam; prosenchymatous; hyphae-thin smooth walls, 1.5-2 μm diam; -c	hyaline; thin, smooth walls; 2-2.5 μm diam; common branching; wefty	cream; 25-120 μm diam; ropy/wefty; glabrous	monopodal/ramiform; .17-.29	M42

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
cream/yellow brown; glabrous; 10-15 μm diam; prosenchymatous; hyphae—thin smooth walls, 2.5 μm diam; -c	absent	absent	trilobate; .22-.28 mm diam.	M25
cream/golden brown; cottony; 10-20 μm diam; prosenchymatous; hyphae—thin smooth walls; 2-2.5 μm diam, +c	hyaline; thin, smooth walls; 2-2.5 μm diam; +c; common branching; cottony	white; 10-26 μm diam; ropy; glabrous; hyphae inflated -8 μm diam.	ramiform; .18-.24 mm diam.	M41A
cream/golden; pubescent; 15-20 μm diam; prosenchymatous; hyphae—thin smooth walls, 2-2.5 μm diam, +c	hyaline; thin, smooth walls; 2.5-3 μm diam; -c; common branching; pubescent	absent	trilobate; .23-.33 mm diam.	M36A
yellow; reticulate; 10-15 μm diam; prosenchymatous; hyphae—3.3.5 μm diam, -c	hyaline; thin, smooth walls; 2-2.5 μm diam; +c; gossamer	yellow; 50 μm diam; ropy; glabrous/ cottony	monopodal; .18-.37 mm diam.	M13B

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
yellow/yellow brown; bristly; 18-30 μm diam; prosenchymatous; hyphae—thick smooth walls, 4-4.5 μm diam; acute setae, thick walls, 4-5 μm diam. at enlarged, septate base, 52-130 μm long	absent	absent	trilobate; .24-.33 mm diam.	M27
yellow/reddish brown feltlike; 26 μm diam; prosenchymatous	hyaline; spiny wall incrustations; 2.5-3 μm diam; -c	absent	monopodal/ trilobate	AB004
golden brown; glabrous; 5-10 μm diam; prosenchymatous	absent	absent	trilobate/ tuberculate .15-.35 mm diam.	M24
golden brown/reddish brown; glabrous; 7-15 μm diam; 2 layers: outer—prosenchymatous, hyphae—thick, smooth walls, 2-3 μm diam, -c; inner—synenchymatous; hyphae—thick, dark walls, -c	hyaline; thick, warty walls; 2-5 μm diam; -c; scattered, singly attached to mantle	absent	trilobate; .19-.25 mm diam.	M41B

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
golden brown/reddish brown; cottony; 5-10 μm diam; prosenchymatous; hyphae—thin smooth walls, 3-4.5 μm diam, -c	hyaline; thin, smooth walls; 2.5-3.5 μm diam; +c; common branching; cottony	golden brown; 15-25 μm diam; ropy; glabrous	bilobate .19-.26 mm diam.	M32C
golden brown/rusty brown; crusty; 20-30 μm diam; prosenchymatous; hyphae—thick walls, -c	hyaline; thick, punctate walls; 2-3 μm diam; +c; infrequent branching; sparse, gossamer	absent	bilobate; .15-.25	M26C
golden brown/brown; glabrous; 8-20 μm diam; prosenchymatous; hyphae—dark, thick, smooth walls, 4-7.5 μm diam; -c; multiple branching	absent	absent	trilobate; .22-.27 mm diam.	M16A
golden brown/dark brown; glabrous; 10-15 μm diam; prosenchymatous; hyphae—2.5-3 μm diam.	absent	absent	trilobate; .21-.37 mm diam.	M13D

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
light gray/gray brown; glabrous; 10-20 μm diam; prosenchymatous; hyphae—thin smooth walls, 2.5-5 μm diam.	hyaline; thin, smooth walls; 2.5-3 μm diam; +c; common branching; cottony	absent	trilobate; .27-.32 mm diam.	M23B
gray/gray brown; glabrous; 12-19 μm diam; prosenchymatous; hyphae—thin smooth walls, 2.5-5 μm diam, -c	hyaline; thick, smooth walls; 1.5-2.5 μm diam; -c; infrequent branching	absent	monopodal/ trilobate; .18-.24 mm diam.	M35B
rusty brown/brown; glabrous; 15-23 μm diam; synenchymatous; hyphae—dark thick smooth walls; 3-6 μm diam, -c	absent	absent	trilobate; .23-.30 mm diam.	M04B
rusty brown/reddish brown; glabrous; 15-20 μm diam; prosenchymatous; hyphae—dark thick smooth walls; 5-6 μm diam; -c	absent	absent	bilobate/ trilobate; .23-.26 mm diam.	M35C
reddish brown/brown; glabrous; 13 μm diam prosenchymatous	hyaline; thin/thick, incrusted walls; 2.6 μm diam; +c; branched	dark brown; 26 μm diam; threadlike; papillose	ramiform/ open pinnate	AB009

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
brown, metallic; cottony; 11-30 μm diam; prosenchymatous hyphae—dark, 1.5-3 μm diam; -c	brown; thin, ornamented walls; 1.5-2.5 μm diam; -c; gossamer	absent	tuberculate; .23-.30 mm diam.	M04B
brown/black; glabrous; 7.5-10 μm diam; prosenchymatous; hyphae—thin smooth walls, 1.5-2.5 μm diam, -c; bulbous cells on surface	absent	absent	bilobate/ ramiform; .15-.26 mm diam.	M04C
coffee/black; granular; 10-20 μm diam; synenchymatous hyphae—dark thick smooth walls, 4-10 μm diam; setae—thick warty walls, occasional branching	black; thick warty walls; 2-6 μm diam; +c; gossamer	absent	bilobate/ trilobate; .21-.37 mm diam.	M13A M35A M37A
olive green/black; granular; 5-6 μm diam; prosenchymatous; hyphae—dark thick walls, 2-5 μm diam, -c, common branching	absent	absent	trilobate; .23-.26 mm diam.	M20A M22A

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	**Attached Mycelium**	**Rhizomorphs**	**Rootlets**	**Root Specimens**
black; bristly; 22-33 μm diam; prosenchymatous; hyphae—dark, thin smooth walls, 2-5 μm diam, -c	black; thin, smooth walls; 2-2.5 μm diam; +c; common branching; bristly	absent	monopodal/ trilobate; .31-.36 mm diam.	M26A
orange/brown, white patches; cottony; 19-20 μm diam; synenchymatous	absent	absent	ramiform	AB008
pinkish orange; cottony; 10-30 μm diam; prosenchymatous; hyphae—thin, smooth walls, 2-3.5 (-5) μm diam, +c	hyaline; thick, smooth walls; 2-5.5 μm diam; +c; common branching; occasional anastomosing cottony	pinkish orange; 30-60 μm diam; spreading ropy/ wefty; cottony	trilobate; .14-.37 mm diam.	M16C M18 M36B M23A M21 M31,
orange pink/orange brown; glabrous; 25-40 μm diam; prosenchymatous; hyphae—2.5-5 μm diam.	hyaline; thin, smooth walls, 3-4 μm diam; +c; common branching	absent	bilobate/ ramiform; .31-.37 mm diam.	M15B
light blue; glabrous; 18-38 μm diam; prosenchymatous; hyphae—thin, smooth walls, 2.5-3 μm diam, -c	absent	absent	tuberculate; .23-.34 mm diam.	M04A

Table III. Arbutoid mycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts (cont.)

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
metallic blue gray; glabrous; 15-30 μm diam; prosenchymatous; hyphae—2-4 μm diam, -c	absent	absent	trilobate/ tuberculate; .18-.31 mm diam.	M11

Table IV. Arbutoid mycorrhizae of *Arbutus menziesii* with unknown fungal symbionts.

Mantle	Attached Mycelium	Rhizomorphs	Rootlets	Root Specimens
golden brown; glabrous; 10-20μm diam; prosenchymatous; hyphae—thick, smooth walls, 2-3 μm diam, -c	absent	absent	trilobate; .23-.26 mm diam.	M39
reddish brown; bristly; 10-18 μm diam; prosenchymatous; hyphae—thin, smooth walls, 2-5 (-6) μm diam, -c	reddish brown; thin, smooth walls; 2-3 μm diam; + μm; +c; infrequent branching, gossamer	reddish brown; 4-19 μm diam; spreading ropy; cottony	monopodal/ ramiform; .19-.27 mm diam.	M29B

Note: +c = clamp connections present
-c = clamp connections absent

Table V. Arbutoid-ericoid mycorrhizae of *Arctostaphylos manzanita* and *Arbutus menziesii.*

Host[a]	**Mantle**	**Attached Mycelium**	**Rhizomorphs**	**Rootlet**	**Root Specimens**
ARMA	gray brown; reticulate; 5-30 μm diam; prosenchymatous; hyphae—thin smooth walls, 2-2.5 μm diam.	hyaline; thin smooth walls 2.25 μm diam; +c gossamer	absent	trilobate/ monopodal .18-.28 mm diam.	M37B
ACME	translucent pale yellow; glabrous; <5 μm diam; synenchymatous	hyaline; smooth walls; 2-2.5 μm diam; gossamer	absent	ramiform; .22-.31 mm diam.	M14

[a] ARMA = *Arctostaphylos manzanita*, ACME = *Arbutus menziesii*

Note: +c = clamp connections present
-c = clamp connections absent

Table VI. Ectomycorrhizae of *Arctostaphylos manzanita* with unknown fungal symbionts.

Mantle	Attached Mycelium	Rhizomorphs	Rootlet	Root Specimens
white/reddish brown; cottony/wefty; 26 μm diam; synenchymatous	hyaline; smooth walls; 2.6 μm diam; +c; branching; wefty	white; 200 μm diam; thread-like; wefty	trilobate	AB019
white, gray brown tinges/dark green; cottony; 26-39 μm diam; synenchymatous; hyphae— peglike wall incrustations, -c	hyaline; peglike/ coralloid incrustations -c	absent	closed pinnate	AB017
pale yellow; felty; 19-20 μm diam; synenchymatous	hyaline; tubercule wall outgrowths; -c; infrequent branching	absent	trilobate	AB007
burnt orange; felty; 21-26 μm diam; prosenchymatous	hyaline; incrusted walls; 2.6-3.9 μm diam; -c; branching	absent	ramiform	AB006
reddish brown/ black; granular; synenchymatous; hyphae-2.5 μm diam, +c	dark; 2.5 μm diam; +c; branching	dark brown; wefty	ramiform	AB014

Note: +c = clamp connections present
-c = clamp connections absent

DISCUSSION

The amount of mycelial and rhizomorph development in the soil surrounding the roots of *Arctostaphylos manzanita* and *Arbutus menziesii* and the abundance and variety of mycorrhizae described, support the hypothesis put forward by Molina and Trappe (1980) that mycorrhizal roots of ericaceous plants may act as a reservoir of fungi that can be used by conifers in forests that are becoming re-established.

Harley (1959) proposed that arbutoid mycorrhizae are intermediate between ectomycorrhizae and ericoid mycorrhizae. Molina and Trappe (1980) hypothesized that the arbutoid form is a type of ectomycorrhiza. The results of the research done in this paper substantiate the theory of a close relationship between different types of mycorrhizae. The difference between types of mycorrhizae may be caused by any number of environmental factors tht affect the ability of the fungus to physically penetrate the cells of the cortex or affect the production of certain fungal or plant hormones. A gradient of environmental factors could result in a number of intermediate forms between two recognized categories of mycorrhizae. The arbutoid-ericoid forms described here and observed by Largent et al. (1980b) illustrate these intergrading forms.

Further research consideration should be given to the relationship between different types of mycorrhizae and to the factors that are the source of variability in types of mycorrhizae.

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CHECK-LIST OF ROMANIAN PERONOSPORALES

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Together with the Uredinales, Ustilaginales and Erysiphales, the Peronosporales have been intensively studied in Romania. The most valuable contributions are those by T. Săvulescu, T. Rayss, C.V. Oescu, I. Rădulescu and O. Săvulescu. Over the years other students have recorded many downy mildews and T. & O. Săvulescu have published a list 'Peronosporaceele din Republica Populară Romană' (Lucr. Grăd. bot. Buc. 1963: 1-146, issued 1964) based on literature data. In a recent paper (Constantinescu & Negrean, Feddes Repert. 93 (9/10) 1982, in press) 8 species and 177 fungus/host combinations were newly recorded for Romania, and 80 plants not previously recorded as hosts were listed. Both the mentioned papers include short surveys of the research done in Romania on these fungi. The available data show that 641 out of c. 3000 phanerogamic taxa of Romanian flora are parasitized by downy mildews. Romania, a relatively small territory, apparently has the richest known flora of Peronosporales.

Although our search through the literature concerning Romanian Peronosporales (about 280 publications) has been thourough, this check-list is only based on an examination of over 5000 specimens of which we collected more than 3000 between 1957-1981, particularly between 1975-1980. We have also collected and preserved new specimens for most of the known fungus/host combination which were not supported by voucher herbarium material. This work was part of a project concerning 'Cryptogamic Flora of Romania'. Almost all of the material studied is preserved in the herbarium BUCM and some specimens are deposited in BUC, CL, CRAF, I, IBIR and SIB herbaria.

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This list comprises only Albuginaceae and Peronosporaceae, *Pythium* and *Phytophthora* (Pythiaceae) were not included because they are little known in Romania. For these two genera only a limited number of herbarium specimens and living cultures are available.

The main difficulty encountered during our study was the absence of a modern, monographic treatment of such important genera as *Peronospora* and *Plasmopara*. Consequently, we had to take some taxonomical decisions, particularly in *Peronospora*, which are not in accordance with most of the published studies. In general, we have recognized only those downy mildew species within a host family, which can be delimited by qualitative morphological features e.g. shape of conidia or sporangia (length/width ratio), oospore ornamentation, tip of ultimate branchlets, and not by quantitative characters such as the size of conidia or other organs. However, in the treatment of *Peronospora* parasitic on some host families (Boraginaceae, Caryophyllaceae, Leguminosae) this principle could not be applied consistently. The oospore ornamentation of *Peronospora* inhabiting these plants proved to have diagnostic value but in many micro-species no oospores could be found. Consequently, they were partly treated in a conservative way. These decisions can be questioned, particularly because they are not based on the study of the type specimens of taxa concerned and, actually, we changed a few times our mind during the final part of our work.

The physiological specialization below host family level, extensively used in the past but only rarely properly proved, was not taken into account for species delimitation. No infraspecific taxa are recognized in this paper and no 'formae speciales' are mentioned, though the latter are often used by plant pathologists.

As a result of a broader species concept that the one adopted by T. & O. Săvulescu (l.c.), the number of 'good' species of Peronosporales was reduced from 254 to 112, although the number of hosts has increased by c. 274 taxa (table 1).

In a few instances authors are cited according to the changed Art. 13 ICBN adopted by the Sydney Bot. Congr. (Taxon 30: 106, 905. 1981). Author's names are abbreviated

Table 1

SYNOPTIC TABLE OF ROMANIAN PERONOSPORALES

GENERA	*number of species*	number of hosts		
		fami-lies	genera	species & subsp.
Albugo	*6*	7	60	141
Basidiophora	*1*	1	1	1
Bremia	*1*	1	23	82
Bremiella	*1*	1	3	3
Peronospora	*88*	32	157	438
Plasmopara	*10*	9	37	57
Pseudoperonospora	*4*	4	4	7
Sclerospora	*1*	1	1	3
TOTAL				
- fungi	*112*	-	-	-
- fungus/host comb.	-	56	286	732
- hosts	-	42	231	641

according to Hawksworth (Rev. Pl. Pathol. 59: 473-480. 1980). The nomenclature of the hosts is in accordance with 'Flora Europaea'. Genera and species are arranged alphabetically, except for *Peronospora* species which are listed according to alphabetically arranged host families; a host-fungus index is added. The first author is responsible for the identification, taxonomy and nomenclature of the fungi and the second author for the same with regard to the host plants.

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ALBUGO (Pers.) Roussel

A. bliti (Biv.-Bern.) Kuntze on Amaranthus albus L., A. blitoides S. Watson, A. ? bouchonii Thell., A. graecizans L., A. hybridus L., A. lividus L., A. retroflexus L.

A. candida (J.F. Gmelin : Fr.) Kuntze on Alyssum alyssoides (L.) L., A. borzeanum E.I. Nyárády, A. caliacrae E.I. Nyárády, A. desertorum Stapf, A. hirsutum Bieb., A. linifolium Stephan ex Willd., A. minutum Schlecht. ex DC., A. murale Waldst. & Kit., A. petraeum Ard., A. saxatile L., A. tortuosum Willd.; Arabidopsis thaliana (L.) Heynh.; Arabis alpina L., A. glabra (L.) Bernh., A. hirsuta (L.) Scop., A. muralis Bertol., A. procurrens Waldst. & Kit., A. recta Vill., A. sagittata (Bertol.) DC., A. turrita L.; Armoracia rusticana P. Gaertner, B. Meyer & Scherb.; Barbarea vulgaris R. Br.; Berteroa incana (L.)DC.; Biscutella laevigata L.; Brassica elongata Ehrh. subsp. elongata; B. juncea (L.) Czern. & Coss., B. napus L. (cult.), B. nigra (L.) Koch, B. oleracea L., B. rapa L. (cult.), B. rapa L. subsp. oleifera DC. (cult.); Bunias orientalis L.; Calepina irregularis (Asso) Thell.; Camelina microcarpa Andrz. ex DC., C. rumelica Velen., C. sativa (L.) Crantz; Capsella bursa-pastoris (L.) Medicus; Cardamine amara L., C. hirsuta L., C. matthiolii Moretti, C. pratensis L.; Cardaminopsis arenosa (L.) Hayek, C. halleri (L.) Hayek subsp. halleri, C. halleri subsp. ovirensis (Wulfen) Hegi & E. Schmidt, C. neglecta (Schultes) Hayek; Cardaria draba (L.) Desv.; Cheiranthus cheiri L. (cult.); Chorispora tenella (Pallas) DC.; Cleome spinosa Jacq. (cult.); Conringia orientalis (L.) Dumort.; Coronopus squamatus (Forskål) Ascherson; Descurainia sophia (L.) Webb ex Prantl; Diplotaxis muralis (L.) DC.; Draba lasiocarpa Rochel (incl. subsp. elongata (Host) Jáv.); Erophila verna (L.) Chevall. subsp. verna; Erysimum cheiranthoides L., E. comatum Pančić, E. crepidifolium Reichenb., E. cuspidatum (Bieb.) DC., E. diffusum Ehrh., E. odoratum Ehrh., E. repandum L., E. witmannii Zawadski; Euclidium syriacum (L.) R. Br.; Hesperis matronalis (cult.); Hornungia petraea (L.) Reichenb.; Hutchinsia alpina (L.) R. Br. subsp. brevicaulis (Hoppe) Arcangeli; Hymenolobus procumbens (L.) Nutt. ex Torrey & A. Gray; Iberis saxatilis L., I. umbellata L.; Isatis tinctoria L.; Lepidium campestre (L.) R. Br., L. cartilagineum (J. Mayer) Thell. subsp. crassifolium (Waldst. & Kit.) Thell., L. densiflorum Schrader, L. latifolium L., L perfoliatum L., L. ruderale L.. Lunaria annua L. subsp. pachyrrhiza (Borbás) Hayek; Neslia paniculata (L.) Desv.; Raphanus raphaniastrum L. subsp. raphaniastrum, R. sativus L. (cult.); Rorippa amphibia (L.) Besser, R. austriaca (Crantz) Besser, R. islandica (Oeder) Borbás, R. pyrenaica (Lam.) Reichenb., R. sylvestris (L.) Besser subsp. sylvestris, R. sylvestris subsp. kerneri (Menyh.) Soó; Sinapis alba L. (cult.), S. arvensis L.; Sisymbrium altissimum L., S. loeselii L., S. officinale (L.) Scop., S. orientale L., S. polymorphum (Murray) Roth; Syrenia cana (Piller & Mitterp.) Neilr., S. montana (Pallas) Klokov; Thlaspi arvense L.; T. perfoliatum L.

A. caryophyllacearum (Wallr.) Cif. & Biga on Spergularia marina (L.) Griseb. (= S. salina J. & C. Presl.), S. media (L.) C. Presl (= S. marginata Kittel).

A. eurotiae Tranzschel on Ceratocarpus arenarius L.

A. portulacae (DC.) Kuntze on Portulaca oleracea L. subsp. oleracea, P. oleracea subsp. sativa (Haw.) Čelak. (cult.)

A. tragopogonis (Pers.) Gray on Ambrosia artemisiifolia L.; Artemisia vulgaris L.; Centaurea atropurpurea Waldst. & Kit., C. kotschyana Heuffel, C. orientalis L., C. ? scabiosa L.; Chamomilla suaveolens (Pursh) Rydb.; Cirsium alatum (S.G. Gmelin) Bobrov (= C. setigerum Ledeb.), C. arvense (L.) Scop., C. canum (L.) Scop., C. erisithales (Jacq.) Scop., C. oleraceum (L.) Scop., C. rivulare (Jacq.) All., C. vulgare (Savi) Ten.; Crepis sancta (L.) Babcock (= Lagoseris sancta (L.) K. Malý); Crupina vulgaris Cass.; Filago vulgaris Lam.; Inula britannica L., I. conyza DC., I. salicina L.; Logfia arvensis (L.) Holub; Scorzonera cana (C.A. Meyer) O. Hoffm., S. hispanica L., S. laciniata L.; Senecio vernalis Waldst. & Kit.; Serratula tinctoria L.; Tragopogon dubius Scop., T. porrifolius L. (cult.), T. pratensis L., s. l.; Xeranthemum annuum L., X. cylindraceum Sibth. & Sm.

BASIDIOPHORA Roze & Cornu

B. entospora Roze & Cornu on Conyza canadensis (L.) Cronq. (= Erigeron canadensis L.).

BREMIA Regel

B. lactucae Regel on Arctium lappa L., A. minus Bernh., A. tomentosum Miller; Carduus acanthoides L., C. crispus L., C. nutans L., C. personata (L.) Jacq., s.l. subsp. albicans (Adamović) Kazmi; Carlina acaulis L., s.l.; Centaurea cyanus L., C. jacea L., C. mollis Waldst. & Kit., C. nigrescens Willd., C. pannonica (Heuffel) Simonkai subsp. pannonica, C. phrygia L. subsp. phrygia, C. phrygia subsp. carpatica (Porcius) Dostál, C. phrygia subsp. melanocalathia (Borbás) Dostál, C. phrygia subsp. pseudophrygia (C.A. Meyer) Gugler, C. rocheliana (Heuffel) Dostál (= C. banatica Rochel ex Hayek, non A. Kerner), C. solstitialis L., s.l., C. stenolepis A. Kerner subsp. stenolepis, C. triumfetti All.; Cephalorrhynchus tuberosus (Steven) Schschian; Cicerbita alpina (L.) Wallr.; Cirsium arvense (L.) Scop., C. canum (L.) All., C. oleraceum (L.) Scop., C. palustre (L.) Scop., C. rivulare (Jacq.) All., C. vulgare (Savi) Ten.; Crepis biennis L., C. foetida L. subsp. rhoeadifolia (Bieb.) Čelak., C. paludosa (L.) Moench, C. pulchra L., C. sancta (L.) Babcock (= Lagoseris sancta (L.) K. Malý), C. setosa Haller fil.; Dimorphotheca pluvialis Moench (cult.); Gazania rigens (L.) Gaertner (= G. splendens E.G. & A. Henderson); Helichrysum bracteatum (Vent.) Andrews (cult.); Hieracium argillaceum Jordan, s.l., H. aurantiacum L., H. bifidum Kit., H. caesium (Fries) Fries, H. caespitosum Dumort., H. cymosum L., H. ? lactucella Wallr., H. lactucella Wallr. subsp. lactucella, H. murorum L., H. pilosella L. subsp. pilosella, H. pilosella subsp. micradenium Negeli & Peter, H. piloselloides Vill. subsp. piloselloides, H. praealtum Vill. ex Gochant, s.l., H. praealtum subsp. bauhinii (Besser) Petunnikov, H. praealtum subsp. thaumasium (Peter) P.D. Sell, H. rotundatum Kit. & Schultes (= H. transsilvanicum Heuffel), H. umbellatum L.; Hypochoeris radicata L.; Lactuca saligna L., L. sativa L. (cult.), L. serriola L., L. viminea (L.) J. & C. Presl; Lapsana communis L., L. intermedia Bieb.; Leontodon autumnalis L., L. hispidus L., s.l.; Mycelis muralis (L.) Dumort.; Onopordum acanthium L., O. tauricum Willd.; Picris echioides L. (= Helminthia echioides (L.) Gaertner), P. hieracioides L., s.l.; Senecio aquaticus Hill subsp. barbareifolius (Wimmer & Grab.) Walters, S. squalidus L. (= S. rupestris Waldst. & Kit.), S. subalpinus Koch, S. vernalis Waldst. & Kit., S. vulgaris L.; Sonchus arvensis L., s.l., S. arvensis subsp. uliginosus (Bieb.) Nyman, S. asper (L.) Hill subsp. asper, S. asper subsp. glaucescens (Jordan) Ball, S. oleraceus L., S. palustris L., Taraxacum 'officinale Weber'; Xeranthemum annuum L.

BREMIELLA G. Wilson

B. baudysii (Skalický) O. Const. & Negrean on Berula erecta (Hudson) Coville (= Sium erectum Hudson); Oenanthe silaifolia Bieb.; Sium latifolium L.

PERONOSPORA Corda

on BORAGINACEAE

P. asperuginis Schröter on Asperugo procumbens L.

P. cerinthe Uliyanishchev ex Jacz. & P.A. Jacz. on Cerinthe minor L.

P. cynoglossi Burrill ex Swingle on Cynoglossum hungaricum Simonkai.

P. echii (L. Krieger) Jacz. & P.A. Jacz. on Echium vulgare L.

P. echinospermi (Swingle) Swingle on Lappula barbata (Bieb.) Gürke, L. marginata (Bieb.) Gürke (= L. patula (Lehm.) Menyh.), L. squarrosa (Retz.) Dumort. subsp. squarrosa (= L. echinata Fritsch).

P. lithospermi Gäum. on Buglossoides arvensis (L.) I.M. Johnston subsp. arvensis (= Lithospermum arvense L.), B. arvensis subsp. sibthorpiana (Griseb.) R. Fernandes, B. glandulosus (Velen.) R. Fernandes (= Lithospermum glandulosum Velen.).

P. myosotidis de Bary on Myosotis alpestris F.W. Schmidt (cult.), M. arvensis (L.) Hill subsp. arvensis, M. discolor Pers. subsp. discolor (= M. versicolor Sm.), M. ramosissima Rochel subsp. ramosissima, M. scorpioides L. (= M. palustris (L.) Hill), M. sparsiflora Mikan ex Pohl, M. stricta Link ex Roemer & Schultes, M. sylvatica Hoffm subsp. sylvatica.

P. rocheliae Kalimbetov on Rochelia disperma (L. fil.) C. Koch subsp. retorta (Pallas) E. Kotejowa.

P. symphyti Gäum. on Symphytum cordatum Waldst. & Kit., S. nodosum Schur, S. officinale L., s.l., S. officinale subsp. uliginosum (A. Kerner) Nyman, S. ottomanum Friv.

on CAMPANULACEAE

P. phyteumatis Fuckel on Phyteuma vagneri A. Kerner.

on CAPPARIDACEAE

P. parasitica (Pers. : Fr.) Fr. on Cleome spinosa Jacq. (cult.).

on CARYOPHYLLACEAE

P. agrostemmatis Gäum. on Agrostemma githago L.

P. alsinearum Casp. on Stellaria media (L.) Vill.

P. **arenariae** (Berk.) Tul. on Moehringia trinervia (L.) Clairv.

P. **campestris** Gäum. on Arenaria serpyllifolia L.

P. **conferta** (Unger) Unger on Cerastium dubium (Bast.) O. Schwarz (= C. anomalum Waldst. & Kit.), C. fontanum Baumg. subsp. triviale (Link) Jalas.

P. **gypsophilae** Jacz. & P.A. Jacz. on Gypsophyla muralis L.

P. **holostei** Casp. ex de Bary on Holosteum umbellatum L., s. l., H. umbellatum subsp. glutinosum (Bieb.) Nyman.

P. **lychnitis** Gäum. on Lychnis alpina L. (cult.), L. viscaria L.

P. **melandrii** Gäum. on Silene alba (Miller) E.H.L. Krause, S. noctiflora L., S. otites (L.) Wibel.

P. **obovata** Bonorden on Spergula arvensis L.; Spergularia marina (L.) Griseb., S. media (L.) C. Presl, S. rubra (L.) J. & C. Presl.

P. **parva** Gäum. on Stellaria holostea L.

P. **scleranthi** Rabenh. on Scleranthus annuus L., s.l., S. uncinatus Schur.

P. **tomentosa** Fuckel on Cerastium arvense L., s.l.(cult.), C. brachypetalum Pers., C. glomeratum Thuill., C. semidecandrum L.

on CHENOPODIACEAE

P. **chenopodii-glauci** Gäum. on Chenopodium glaucum L.

P. **farinosa** (Fr.) Fr. on Atriplex hastata L., A. hortensis L. (cult.), A. nitens Schkuhr, A. oblongifolia Waldst. & Kit., A. patula L., A. rosea L., A. tatarica L.; Beta vulgaris L. (cult.); Ceratocarpus arenarius L.; Chenopodium album L., s.l., C. ambrosioides L., C. bonus-henricus L., C. ficifolium L., C. hybridum L., C. murale L., C. opulifolium Schrader ex Koch & Ziz, C. polyspermum L., C. urbicum L., C. vulvaria L.; Halimione verrucifera (Bieb.) Aellen (= Obione verrucifera (Bieb.) Moq.); Kochia scoparia (L.) Schrader (cult.); Spinacia oleracea L. (cult.).

P. **vistulensis** Wróbl. on Corispermum nitidum Kit.; Salsola kali L., S. kali L. subsp. ruthenica (Iljin) Soó.

on CISTACEAE

P. **leptoclada** Sacc. on Helianthemum canum (L.) Baumg. subsp.

canum, H. nummularium (L.) Miller, s.l., H. nummularium subsp. nummularium, H. nummularium subsp. obscurum (Čelak.) J. Holub, H. oelandicum (L.) DC. subsp. alpestre (Jacq.) Breistr., H. salicifolium (L.) Miller.

on COMPOSITAE

P. leptosperma de Bary on Anthemis arvensis L., A. austriaca Jacq., A. cotula L.; Artemisia absinthium L., A. annua L.; Chamomilla recutita (L.) Rauschert, C. suaveolens (Pursh) Rydb.; Leucanthemum nipponicum Franch. (= Chrysanthemum nipponicum Matsum.) (cult.); Matricaria perforata Mérat (= M. inodora L.); Tanacetum vulgare L.

P. radii de Bary on Anthemis ruthenica Bieb.; Matricaria perforata Mérat.

on CRUCIFERAE

P. lepidii (McAlp.) G. Wilson on Coronopus squamatus (Forskål) Ascherson; Lepidium densiflorum Schrader, L. ruderale L.

P. niessleana Berl. on Alliaria petiolata (Bieb.) Cavara & Grande.

P. parasitica (Pers. : Fr.) Fr. on Alyssum alyssoides (L.) L., A. desertorum Stapf, A. hirsutum Bieb., A. linifolium Stephan ex Willd., A. minutum Schlecht. ex DC., A. murale Waldst. & Kit., A. petraeum Ard., A. saxatile L.; Arabidopsis thaliana (L.) Heynh.; Arabis alpina L., A. glabra (L.) Bernh., A. hirsuta (L.) Scop., A. turrita L.; Armoracia rusticana P. Gaertner, B. Meyer & Scherb.; Barbarea vulgaris R. Br.; Berteroa incana (L.) DC., Brassica elongata Ehrh. subsp. elongata, B. juncea (L.) Czern. & Coss., B. napus L. (cult.), B. nigra (L.) Koch, B. oleracea L., incl. cvars, B. rapa L., s.l., B. rapa subsp. oleifera DC. (cult.) Bunias orientalis L.; Calepina irregularia (Asso) Thell.; Camelina microcarpa Andrz. ex DC., C. rumelica Velen., C. sativa (L.) Crantz; Capsella bursa-pastoris (L.) Medicus; Cardamine bulbifera (L.) Crantz (= Dentaria bulbifera L.), C. flexuosa With., C. glanduligera O. Schwarz (= Dentaria glandulosa Waldst. & Kit.), C. graeca L., C. hirsuta L., C. impatiens L., C. matthiolii Moretti; Cardaminopsis arenosa (L.) Hayek; Cardaria draba (L.) Desv. subsp. draba; Cheiranthus cheiri L. (cult.); Chorispora tenella (Pallas) DC., Cochlearia pyrenaica DC., var. borzeana Coman & E.I. Nyárády, Conringia orientalis (L.) Dumort.; Descurainia sophia (L.) Webb ex Prantl (= Sisymbrium sophia L.); Diplotaxis muralis L., D. tenuifolia (L.) DC.; Draba nemorosa L.; Erophila verna (L.) Chevall., s.l.; Erucastrum nasturtiifolia (Poiret) O.E. Schulz; Erysimum cheiranthoides L., E. cuspidatum (Bieb.) DC. (= Syrenia cuspidata L.), E. diffusum Ehrh., E. odoratum Ehrh., E. repandum ;, E. witmannii Zawadski, s.l.; Euclidium syriacum (L.) R. Br.; Hesperis matronalis L., s. l., H. sylvestris Crantz subsp. velenovskyi (Fritsch) Borza; Iberis umbellata L.; Isatis tinctoria L., s.l.; Lepidium campestre (L.) R. Br., L. densiflorum Schrader, L. latifolium L., L. perfoliatum L.; Lobularia maritima (L.) Desv. (cult.); Lunaria annua L. subsp. pachyrrhiza (Borbás) Hayek, L. rediviva L.; Matthiola incana (L.) R. Br. subsp. incana (cult.), M. longipetala (Vent.) DC. subsp. bicornis (Sibth. & Sm.) P.W. Ball; Nasturtium officinale R. Br.; Neslia paniculata (L.) Desv., s.l.; Peltaria alliacea Jacq.; Raphanus raphaniastrum L. subsp. raphaniastrum, R. raphaniastrum subsp. landra (Moretti ex DC.) Bonnier & Layens, R. sativus L. (cult.); Rapistrum perenne (L.) All.; Rorippa amphibia (L.) Besser, R. x armoracioides (Tausch) Fuss, R. austriaca (Crantz) Besser, R. islandica (Oeder) Borbás, R. sylvestris (L.) Besser subsp. sylvestris; Sinapis alba L. (cult.), S. arvensis L.; Sisymbrium altissimum L., S. loeselii L., S. officinale (L.) Scop., S. orientale L., S. polymorphum (Murray) Roth, S. strictissimum L.; Syrenia montana (Pallas) Klokov; Thlaspi arvense L., T. perfoliatum L.

on DIPSACACEAE

P. cephalariae-laevigatae Săvul. & Rayss on Cephalaria laevigata (Waldst. & Kit.) Schrader, C. uralensis (J. Murray) Schrader subsp. multifida (Roman) Roman & Beldie.

P. dipsaci Tul. ex de Bary on Dipsacum fullonum L. (= D. sylvestris Hudson), D. laciniatus L., D. sativus (L.) Honckeny (cult.).

P. knautiae Fuckel ex Schröter on Cephalaria transylvanica (L.) Roemer & Schultes; Knautia arvensis (L.) Coulter, K. ? dipsacifolia Kreutzer s.l., K. drymeia Heuffel subsp. drymeia; Scabiosa columbaria L. subsp. columbaria (= S. banatica Waldst. & Kit.), S. lucida Vill. subsp. lucida, S. ochroleuca L.

P. violacea Berk. & Cooke on Knautia arvensis (L.) Coulter (in flowers); Scabiosa columbaria L. (in flowers).

on EUPHORBIACEAE

P. cyparisiae de Bary on Euphorbia amygdaloides L., E. cyparissias L., E. esula L. subsp. tommasiniana (Bertol.) Nyman (= E. virgata auct.).

P. euphorbiae Fuckel on Euphorbia ? serrulata Thuill.

P. valesiaca Gäum. on Euphorbia seguierana Necker (= E. gerardiana Jacq.).

on GENTIANACEAE

P. erythraeae Kühn ex Gäum. on Centaurium erythraea Rafn subsp. erythraea, C. pulchellum (Swartz) Druce.

on GERANIACEAE

P. conglomerata Fuckel on Erodium ciconium (L.) L'Hér., E. cicutarium (L.) L'Hér., E. hoefftianum C.A. Meyer (incl. E. neilreichii Janka); Geranium columbinum L., G. dissectum L., G. lucidum L., G. molle L., G. phaeum L., G. pusillum L., G. robertianum L., G. sylvaticum L.

on LABIATAE

P. lamii A. Braun on Acinos alpinus (L.) Moench subsp. alpinus, A. alpinus subsp. majoranifolius (Miller) P.W. Ball, A. arvensis (Lam.) Dandy; Lamium album L., L. amplexicaule L., L. garganicum L. subsp. laevigatum Arcangeli (= L. bithynicum Bentham), L. maculatum L., L. purpureum L.; Leonurus marrubiastrum L.; Stachys palustris L.; Ziziphora capitata L.

P. stigmaticola Raunkiaer on Mentha longifolia (L.) Hudson (in flowers).

on LEGUMINOSAE

P. aestivalis H. Sydow in Gäum. on Medicago falcata L., M. sativa L. (cult.); Melilotus alba Medicus, M. officinalis (L.) Pallas.

P. astragalina H. Sydow on Astragalus cicer L., A. hamosus L., A. onobrychis L.

P. coronillae Gäum. on Coronilla scorpioides (L.) Koch, C. varia L.

P. ervi A. Gust. on Vicia hirsuta (L.) S.F. Gray.

P. lotorum H. Sydow on Lotus tenuis Waldst. & Kit. ex Willd.

P. manshurica (Naum.) H. Sydow on Glycine max (L.) Merr. (cult.).

P. medicaginis-minimae Gaponenko on Medicago lupulina L., M. minima (L.) Bartal.

P. senneniana Frag. & Sacc. on Lathyrus niger (L.) Bernh. subsp. niger, L. palustris L., L. tuberosus L.

P. tetragonolobi Gäum. on Tetragonolobus maritimus (L.) Roth (= T. siliquosus (L.) Roth).

P. trifoliorum de Bary on Trifolium alpestre L., T. arvense L., T. badium L., T. campestre Schreber, T. dubium Sibth., T. echinatum Bieb., T. hybridum L., T. hybridum subsp. elegans (Savi) Ascherson & Graebner, T. medium L., s.l., T. medium subsp. banaticum (Heuffel) Hendrych, T. montanum L., T. pratense L. (cult.), T. repens L., T. spadiceum L., T. striatum L.

P. viciae (Berk.) Casp. on Galega officinalis L.; Lathyrus cicera L., L. hirsutus L., L. nissolia L., L. sphaericus Retz., L. sylvestris L.; Pisum sativum L. subsp. sativum (cult.); Vicia angustifolia L., V. cracca L., V. grandifolia Scop., V. lathyroides L., V. lutea L. subsp. lutea, V. narbonensis L., V. pannonica Crantz, s.l., V. pannonica subsp. striata (Bieb.) Nyman, V. peregrina L., V. pisiformis L., V. sativa L. (cult.), V. sepium L., V. tetrasperma L., V. villosa Roth.

on LILIACEAE

P. destructor (Berk.) Casp. in Berk. on Allium cepa L. (cult.), A. fistulosum L. (cult.).

on LINACEAE

P. lini Schröter on Linum catharticum L.

on PAPAVERACEAE

P. affinis Rossm. on Fumaria officinalis L., F. schleicheri Soyer-Willemet, F. vaillantii Loisel.

P. arborescens (Berk.) Casp. on Papaver dubium L., P. rhoeas L., P. somniferum L. (cult.).

P. corydalis de Bary on Corydalis bulbosa (L.) DC. subsp. marschalliana (Pallas) Chater, C. solida (L.) Schwarz; Glaucium corniculatum (L.) J.H. Rudolph.

P. cristata Tranzschel on Papaver hybridum L.

P. corydalis-intermediae Gäum. on Corydalis capnoides (L.) Pers.

on PLANTAGINACEAE

P. alta Fuckel on Plantago altissima L., P. cornuti Gouan, P. lanceolata L., P. major L., s.l., P. major subsp. intermedia (DC) Arcangeli, P. media L., s.l.

P. plataginis Burrill on P. arenaria Waldst. & Kit. (= P.

indica L.), P. major L., s.l.

on PLUMBAGINACEAE

P. statices Lobik on Limonium gmelinii (Willd.) Kuntze, L. vulgare Miller subsp. serotinum (Reichenb.) Gams (= Statice limonium L.)

on POLYGONACEAE

P. ducometii Siem. & Jank. on Fagopyrum esculentum Moench (cult.).

P. polygoni Thüm. ex A. Fischer on Polygonum arenarium Waldst. & Kit. subsp. arenarium, P. aviculare L.

P. polygoni-convolvuli A. Gust. on Bilderdykia convolvulus (L.) Dumort.

P. rumicis Corda on Rumex acetosa L., R. acetosella L., R. alpestris Jacq. (= R. arifolius All.), R. tuberosus L. subsp. tuberosus.

on PRIMULACEAE

P. androsaces Niessl on Androsace elongata L.; Primula veris L.

on RANUNCULACEAE

P. ficariae Tul. ex de Bary on Helleborus purpurascens Waldst. & Kit.; Ranunculus acris L. subsp. acris, R. acris subsp. strigulosus (Schur) Hyl. (= R. stevenii auct.), R. bulbosus L. subsp. bulbosus, R. cassubicus L., R. carpaticus Herbich, R. constantinopolitanus (DC.) D'Urv., R. crenatus Waldst. & Kit., R. ficaria L., R. flammula L., s.l., R. lateriflorus DC., R. oreophilus Bieb., R. oxyspermus Willd., R. pedatus Waldst. & Kit., R. platanifolius L., R. polyanthemos L. subsp. polyanthemos, R. pseudomontanus Schur, R. repens L., R. sardous Crantz.

P. illyrica Gäum. on Ranunculus illyricus L.

P. parvula A. Schneider ex Jacz. & P.A. Jacz. on Isopyrum thalictroides L.

on RESEDACEAE

P. crispula Fuckel on Reseda lutea L., R. phyteuma L.

on ROSACEAE

P. potentillae de Bary on Potentilla aurea L. subsp. aurea, P. aurea L. subsp. chrysocraspeda (Lehm.) Nyman (= P. ternata C. Koch).

P. sparsa Berk. ex Berk & Broome on Alchemilla glabra Neygenf., A. 'hybrida' auct., A. 'vulgaris' auct., A. xanthochlora Rothm.; Aremonia agrimonoides (L.) DC. subsp. agrimonoides; Fragaria vesca L.; Geum aleppicum Jacq., G. coccineum Sibth. & Sm. (cult.), G. rivale L., G. urbanum L.; Potentilla anserina L., P. reptans L.; Rosa gallica L.; Rubus caesius L., R. canescens DC., R. hirsutus Waldst. & Kit., R. idaeus L.; Sanguisorba minor Scop.

on RUBIACEAE

P. calotheca de Bary on Asperula purpurea (L.) Ehrend. subsp. purpurea (= Galium purpureum L.); Cruciata pedemontana (Bellardi) Ehrend. (= Galium pedemontanum (Bellardi) All.).; Galium album Miller, G. aparine L., G. boreale L., G. divaricatum Pourret ex Lam., G. humifusum Bieb., G. mollugo L., G. odoratum Scop. (= Asperula odorata L.), G. palustre L., G. rubioides L., G. schultesii Vest., G. spurium L., G. tricornutum Dandy, G. verum L. subsp. verum.

P. sherardiae Fuckel on Sherardia arvensis L.

on SAXIFRAGACEAE

P. chrysosplenii Fuckel on Chrysosplenium alternifolium L.

on SCROPHULARIACEAE

P. grisea (Unger) Unger on Chaenorrhinum minus (L.) Lange subsp. minus; Digitalis grandiflora Miller; Euphrasia pectinata Ten.; Linaria genistifolia (L.) Miller subsp. genistifolia, L. vulgaris Miller; Veronica anagallis-aquatica L., V. anagalloides Guss., V. becccabunga L., V. catenata Pennell (= V. aquatica Bernh., non S.F. Gray), V. officinalis L., V. scardica Griseb., V. scutellata L., V. serpyllifolia L., V. serpyllifolia subsp. humifusa (Dickson) Syme, V. spicata L. subsp. spicata, V. urticifolia Jacq.

P. melampyri (Bucholtz) J. Davis on Linaria genistifolia (L.) Miller subsp. genistifolia , L. vulgaris Miller (in flowers); Malampyrum arvense L., M. cristatum L., M. saxosum Baumg.; Rhinanthus rumelicus Velen.

P. sordida Berk. & Broome on Scrophularia nodosa L., S. scopolii Hoppe; Verbasum banaticum Schrader, V. blattaria L., V. densiflorum Bertol. (= V. thapsiforme Schrader) (cult.), V. glabratum Frib. subsp. glabratum, V. nigrum L., s.l., V. phlomoides L., V. speciosum Schrader, V. thapsus L., s.l., V. thapsus subsp. crassifolium (Lam.) Murb. (= V. montanum Schrader); Veronica arvensis L., V. austriaca L. subsp. teucrium (L.) D.A. Webb (= V. teucrium L.), V. chamaedrys L., s.l., V. hederifolia L., V. persica Poiret, V. polita Fries (= V. didyma auct., vix Ten.), V. praecox All., V. prostrata L.

on SOLANACEAE

P. **hyoscyami** de Bary on Hyoscyamus niger L.

P. **tabacina** Adam on cultivated Nicotiana alata Link & Otto, N. ipomopsiflora Dun., N. langsdorfii Schrank, N. longiflora Cav., N. nodiflora Cav., N. paniculata L., N. rustica L., N. suaveolens Lehm., N. tabacum L.

on URTICACEAE

P. **debaryi** E. Salmon & Ware on Urtica urens L.

on VALERIANACEAE

P. **valerianae** Trail on Valeriana officinalis L.

P. **valerianellae** Fuckel on Valerianella dentata Pollich, V. lasiocarpa (Steven) Betcke, V. locusta (L.) Letterade, V. pumila (L.) DC., V. rimosa Bast.

on VIOLACEAE

P. **violae** de Bary ex Schröter on Viola arvensis Murray, V. kitaibeliana Schultes, V. tricolor L. subsp. tricolor.

on ZYGOPHYLLACEAE

P. **tribulina** Pass. on Tribulus terrestris L.

PLASMOPARA Schröter

P. **densa** (Rabenh.) Schröter on Euphrasia rostkoviana Hayne, s.l., E. stricta D. Wolff ex J.F. Lehm.; Odontites verna (Bellardi) Dumort., s.l.; Rhinanthus alpinus Baumg., R. angustifolius C.C. Gmelin, R. minor L., R. rumelicus Velen., R. wagneri Degen.

P. **epilobii** (Otth) Sacc. & Sydow on Epilobium hirsutum L., E. palustre L., E. parviflorum Schreber, E. roseum Schreber, E. tetragonum L. subsp. lamyi (F.W. Schultz) Nyman.

P. **halstedii** (Farlow) Berl. & de Toni on Carthamus tinctorius L. (cult.); Dimorphotheca sinuata DC. (cult.); Helianthus annuus L. (cult.); Xanthium italicum Moretti, X. strumarium L.

P. **obducens** (Schröter) Schröter on Impatiens noli-tangere L.

P. **pusilla** (de Bary) Schröter on Geranium pratense L., G.

sylvaticum L.

P. pygmaea (Unger) Schröter on Anemone nemorosa L., A. ranunculoides L.; Helleborus odorus Waldst. & Kit. subsp. odorus , H. purpurascens Waldst. & Kit.; Isopyrum thalictroides L.

P. skvortzovii Miura on Abutilon theophrasti Medicus.

P. sphaerosperma Săvul. on Tragopogon dubius Scop.

P. umbelliferarum (Casp.) Schröter ex Wartenw. on Aegopodium podagraria L.; Ammi majus L. (cult.); Angelica archangelica L., A. sylvestris L.; Anthriscus nitida (Wahlenb.) Garcke, A. sylvestris (L.) Hoffm.; Apium graveolens L. (cult.); Caucalis platycarpos L.; Conium maculatum L.; Daucus carota L. (cult.); Ferulago campestris (Besser) Grec.; Foeniculum vulgare Miller (cult.); Laserpitium latifolium L.; Levisticum officinale Koch (cult.); Ligusticum mutellina (L.) Crantz; Meum athamanticum Jacq,; Pastinaca sativa L., s.l. (spont. & cult.); Petroselinum crispum (Miller) A.W. Hill (cult.); Peucedanum alsaticum L., P. austriacum (Jacq.) Koch, P. palustre (L.) Moench; Pimpinella major (L.) Hudson, P. saxifraga L.; Sanicula europaea L.; Silaum silaus (L.) Schinz & Thell.; Smyrnium perfoliatum L.

P. viticola (Berk. & M.A. Curtis) Berl. & de Toni on Vitis vinifera L. subsp. vinifera (cult.), V. vinifera subsp. sylvestris (C.C. Gmelin) Hegi, V. vinifera x American species (cult.).

PSEUDOPERONOSPORA Rostovtsev

P. cannabina (Otth) Curzi on Cannabis ruderalis Janisch., C. sativa L. (cult.).

P. cubensis (Berk. & M.A. Curtis) Rostovtsev on Cucumis melo L. (cult.), C. sativus L. (cult.)

P. humuli (Miyabe & Takahashi) G. Wilson on Humulus lupulus L. (cult. & spont.).

P. urticae (Lib. ex Berk.) E. Salmon & Ware on Urtica dioica L., U. kioviensis Rogow.

SCLEROSPORA Schröter

S. graminicola (Sacc.) Schröter on Setaria italica (L.) Beauv., S. verticillata (L.) Beauv., S. viridis (L.) Beauv.

HOST-FUNGUS INDEX

Host trinomials refer to subspecies. Whenever consecutive host species are parasitized by the same fungus, the fungal name is only mentioned after the last host listed. The following abbreviations are used throughout for fungal generic and specific epithets: *A.* = *Albugo; B.* = *Bremia; Ba.* = *Basidiophora; Bl.* = *Bremiella; P.* = *Peronospora; Pl.* = *Plasmopara; Ps.* = *Pseudoperonospora; S.* = *Sclerospora*; *cand.* = *candida; lact.* = *lactucae; paras.* = *parasitica; trag.* = *tragopogonis; umbel.* = *umbelliferarum.*

ABUTILON theophrasti: *Pl. skvortzovii.* ACINOS alpinus alpinus, alpinus majoranifolius, arvensis: *P. lamii.* AEGOPODIUM podagraria: *Pl. umbel.* AGROSTEMMA githago: *P. agrostemmatis.* ALCHEMILLA glabra, 'hybrida', 'vulgaris', xanthochlora: *P. sparsa.* ALLIARIA petiolata: *P. niessleana.* ALLIUM cepa, fistulosum: *P. destructor.* ALYSSUM alyssoides: *A. cand., P. paras.*; borzeanum, caliacrae: *A. cand.*; desertorum, hirsutum, linifolium, minutum, murale, petraeum, saxatile: *A. cand., P. paras.*; tortuosum: *A. cand.* AMARANTHUS albus, blitoides, ? bouchonii, graecizans, hybridus, lividus, retroflexus: *A. bliti.* AMBROSIA artemisiifolia: *A. trag.* AMMI majus: *Pl. umbel.* ANDROSACE elongata: *P. androsaces.* ANEMONE nemorosa, ranunculoides: *Pl. pygmaea.* ANGELICA archangelica, sylvestris: *Pl. umbel.* ANTHEMIS arvensis, austriaca, cotula: *P. leptosperma*; ruthenica: *P. radii.* ANTHRISCUS nitida, sylvestris: *Pl. umbel.* APIUM graveolens: *Pl. umbel.* ARABIDOPSIS thaliana: *A. cand., P. paras.* ARABIS alpina, glabra, hirsuta: *A. cand., P. paras.*; muralis, procurrens, recta, sagittata: *A. cand.*; turrita: *A. cand., P. paras.* ARCTIUM lappa, minus, tomentosum: *B. lact.* AREMONIA agrimonoides agrimonoides: *P. sparsa.* ARENARIA serpyllifolia: *P. campestris.* ARMORACIA rusticana: *A. cand., P. paras.* ARTEMISIA absinthium, annua: *P. leptosperma*; vulgaris: *A. trag.* ASPERUGO procumbens: *P. asperuginis.* ASPERULA purpurea: *P. calotheca.* ASTRAGALUS cicer, hamosus, onobrychis: *P. astragalina.* ATRIPLEX hastata, hortensis, nitens, oblongifolia, patula, rosea, tatarica: *P. farinosa.* BARBAREA vulgaris: *A. cand., P. paras.* BERTEROA incana: *A. cand., P. paras.* BERULA erecta: *Bl. baudysii.* BETA vulgaris: *P. farinosa.* BILDERDYKIA convolvulus: *P. polygoni-convolvuli.* BISCUTELLA laevigata: *A. cand.* BRASSICA elongata elongata, juncea, napus, nigra, oleracea, rapa, rapa oleifera: *A. cand., P. paras.* BUGLOSSOIDES arvensis arvensis, arvensis sibthorpiana, glandulosus: *P. lithospermi.* BUNIAS orientalis: *A. cand., P. paras.* CALEPINA irregularis: *A. cand., P. paras.* CAMELINA microcarpa, rumelica, sativa: *A. cand., P. paras.* CANNABIS ruderalis, sativa: *Ps. cannabina.* CAPSELLA bursa-pastoris: *A. cand., P. paras.* CARDAMINE amara: *A. cand.*; bulbifera, flexuosa, glanduligera, graeca: *P. paras.*; hirsuta: *A. cand., P. paras.*; impatiens: *P. paras.*; matthiolli: *A. cand., P. paras.*; pratensis: *A. cand.* CARDAMINOPSIS arenosa: *A. cand., P. paras.*; halleri halleri, halleri ovirensis, neglecta: *A. cand.* CARDARIA draba: *A. cand., P. paras.* CARDUUS acanthoides, crispus, nutans, personata albicans: *B. lact.* CARLINA acaulis: *B. lact.* CARTHAMUS tinctorius: *Pl. halstedii.* CAUCALIS platycarpos: *Pl. umbel.* CENTAUREA atropurpurea: *A. trag.*; cyanus, jacea: *B. lact.*; kotschyana: *A. trag.*; mollis, nigrescens: *B. lact.*; orientalis: *A. trag.*; pannonica pannonica, phrygia carpatica, phrygia melanocalathia, phrygia phrygia, phrygia pseudophrygia, rocheliana: *B. lact.*; ? scabiosa: *A. trag.*; solstitialis, stenolepis, triumfetti: *B. lact.* CENTAURIUM erythraea erythraea, pulchellum: *P. erythraeae.* CEPHALARIA laevigata: *P. cephalariae-*

laevigatae; transylvanica: *P. knautiae*; uralensis multifida: *P. cephalariae-laevigatae*. CEPHALORRHYNCHUS tuberosus: *B. lact.* CERASTIUM arvense, brachypetalum: *P. tomentosa*; dubium, fontanum triviale: *P. conferta*; glomeratum, semidecandrum: *P. tomentosa*. CERATOCARPUS arenarius: *A. eurotiae*, *P. farinosa*. CERINHTE minor: *P. cerinthe*. CHAENORRHINUM minus: *P. grisea*. CHAMOMILLA recutita: *P. leptosperma*; suaveolens: *A. trag.*, *P. leptosperma*. CHEIRANTHUS cheiri: *A. cand.*, *P. paras.* CHENOPODIUM album, ambrosioides, bonus-henricus, ficifolium: *P. farinosa*; glaucum: *P. chenopodii-glauci*; hybridum, murale, opulifolium, polyspermum, urbicum, vulvaria: *P. farinosa*. CHORISPORA tenella: *A. cand.*, *P. paras.* CHRYSOSPLENIUM alternifolium: *P. chrysosplenii*.CICERBITA alpina: *B. lact.* CIRSIUM alatum: *A. trag.*; arvense, canum: *A. trag.*, *B. lact.*; erisithales: *A. trag.*; oleraceum: *A. trag.*, *B. lact.*; palustre: *B. lact.* rivulare, vulgare: *A. trag.*, *B. lact.* CLEOME spinosa: *A. cand.*, *P. paras.* COCHLEARIA pyrenaica var. borzeana: *P. paras.* CONIUM maculatum: *P. umbel.* CONRINGIA orientalis: *A. cand.*, *P. paras.* CONYZA canadensis: *Ba. entospora*. CORISPERMUM nitidum: *P. vistulensis*. CORONILLA scorpioides, varia: *P. coronillae*. CORONOPUS squamatus: *A. cand.*, *P. lepidii*. CORIDALIS bulbosa marschalliana: *P. corydalis*; capnoides: *P. corydalis-intermediae*; solida: *P. corydalis*. CREPIS biennis, foetida rhoeadifolia, paludosa, pulchra: *B. lact.*; sancta: *A. trag.*, *B. lact.*; setosa: *B. lact.* CRUCIATA pedemontana: *P. calotheca*. CRUPINA vulgaris: *A. trag.* CUCUMIS melo, sativus: *Ps. cubensis*. CYNOGLOSSUM hungaricum: *P. cynoglossi*. DAUCUS carota: *Pl. umbel.* DESCURAINIA sophia: *A. cand.*, *P. paras.* DIGITALIS grandiflora: *P. grisea*. DIMORPHOTHECA pluvialis: *B. lact.*; sinuata: *Pl. halstedii*. DIPLOTAXIS muralis: *A. cand.*, *P. paras.*; tenuifolia: *P. paras.* DRABA lasiocarpa: *A. cand.*; nemorosa: *P. paras.* DIPSACUS fullonum, laciniatus, sativus: *P. dipsaci*. ECHIUM vulgare: *P. echii*. EPILOBIUM hirsutum, palustre, parviflorum, roseum, tetragonum: *Pl. epilobii*. ERODIUM ciconium, cicutarium, hoefftianum: *P. conglomerata*. EROPHILA verna s.l.: *P. paras.*; verna verna: *A. cand.*ERUCASTRUM nasturtiifolia: *P. paras.* ERYSIMUM cheiranthoides: *A. cand.*, *P. paras.*; comatum, crepidifolium: *A. cand.*; cuspidatum, diffusum, odoratum, repandum, witmannii: *A. cand.*, *P. paras.* EUCLIDIUM syriacum: *A. cand.*, *P. paras.* EUPHORBIA amygdaloides, cyparissias, esula tommasiniana: *P. cyparissiae*; seguierana: *P. valesiaca*; ? serrulata: *P. euphorbiae*. EUPHRASIA pectinata: *P. grisea*; rostkoviana, stricta: *Pl. densa*. FAGOPYRUM esculentum: *P. ducometii*.FERULAGO campestris: *Pl. umbel.* FILAGO vulgaris: *A. trag.* FOENICULUM vulgare: *Pl. umbel.* FRAGARIA vesca: *P. sparsa*. FUMARIA officinalis, schleicheri, vaillantii: *P. affinis*. GALEGA officinalis: *P. viciae*. GALIUM album, aparine, boreale, divaricatum, humifusum, mollugo, odoratum, palustre, rubioides, schultesii, spurium, tricornutum, verum verum: *P. calotheca*. GAZANIA rigens: *B. lact.* GERANIUM columbinum, dissectum, lucidum, molle, phaeum: *P. conglomerata*; pratense: *Pl. pusilla*; pusillum, robertianum: *P. conglomerata*; sylvaticum: *P. conglomerata*, *Pl. pusilla*. GEUM aleppicum, coccineum, rivale, urbanum: *P. sparsa*. GLAUCIUM corniculatum: *P. corydalis*. GLYCINE max: *P. manshurica*. GYPSOPHILA muralis: *P. gypsophilae*. HALIMIONE verrucifera: *P. farinosa*. HELIANTHEMUM canum canum, nummularium s.l., nummularium nummularium, nummularium obscurum , oleandicum alpestre, salicifolium: *P. leptoclada*. HELIANTHUS annuus : *Pl. halstedii*. HELICHRYSUM bracteatum: *B. lact.* HELLEBORUS odorus odorus: *Pl. pygmaea*; purpurascens: *P. ficariae*, *Pl. pygmaea*. HESPERIS matronalis: *A. cand.*, *P. paras.*; sylvestris velenovskyi: *P. paras.* HIERACIUM argillaceum, aurantiacum, bifidum, caesium, caespitosum, cymosum, ? lactucella, lactucella lactucella, murorum, pilosella micradenium, pilosella pilosella, piloselloides piloselloides, praealtum s.l., praealtum bauhinii, praealtum thaumasium, rotundatum, umbellatum: *B.*

lact. HOLOSTEUM umbellatum s.l., umbellatum glutinosum: *P. holostei.* HORNUNGIA petraea: *A. cand.* HUMULUS lupulus: *Ps. humuli.* HUTCHINSIA alpina brevicaulis: *A. cand.* HYMENOLOBUS procumbens: *A. cand.* HYOSCYAMUS niger: *P. hyoscyami.* HYPOCHOERIS radicata: *B. lact.* IBERIS saxatilis: *A. cand.*; umbellata: *A. cand., P. paras.* IMPATIENS noli-tangere: *Pl. obducens.* INULA britannica, conyza, salicina: *A. trag.* ISATIS tinctoria: *A. cand., P. paras.* ISOPYRUM thalictroides: *P. parvula, Pl. pygmaea.* KNAUTIA arvensis: *P. knautiae, P. violacea*; ? dipsacifolia, drymeia drymeia: *P. knautiae.* KOCHIA scoparia: *P. farinosa.* LACTUCA saligna, sativa, serriola, viminea: *B. lact.* LAMIUM album, amplexicaule, garganicum laevigatum, maculatum, purpureum: *P. lamii.* LAPPULA barbata, marginata, squarrosa: *P. echinospermi.* LAPSANA communis, intermedia: *B. lact.* LASERPITIUM latifolium: *Pl. umbel.* LATHYRUS cicera, hirsutus: *P. viciae*; niger: *P. senneniana*; nissolia: *P. viciae*; palustris: *P. senneniana*; sphaericus, sylvestris: *P. viciae*; tuberosus: *P. senneniana.* LEONTODON autumnalis, hispidus s.l.: *B. lact.* LEONURUS marrubiastrum: *P. lamii.* LEPIDIUM campestre: *A. cand., P. paras.*; cartilagineum crassifolium: *A. cand.*; densiflorum: *A. cand., P. lepidii, P. paras.*; latifolium, perfoliatum: *A. cand., P. paras.*; ruderale: *A. cand., P. lepidii.* LEUCANTHEMUM nipponicum: *P. leptosperma.* LEVISTICUM officinale: *Pl. umbel.* LIGUSTICUM mutellina: *Pl. umbel.* LIMONIUM gmelinii, vulgare serotinum: *P. staticis.* LINARIA genistifolia genistifolia, vulgaris: *P. grisea, P. melampyri.* LINUM catharticum: *P. lini.* LOBULARIA maritima: *P. paras.* LOGFIA arvensis: *A. trag.* LOTUS tenuis: *P. lotorum.* LUNARIA annua pachyrrhiza: *A. cand., P. paras.*; rediviva: *P. paras.* LYCHNIS alpina, viscaria: *P. lychnitis.* MATRICARIA perforata: *P. leptosperma, P. radii.* MATTHIOLA incana incana, longipetala bicornis: *P. paras.* MEDICAGO falcata: *P. aestivalis*; lupulina, minima: *P. medicaginis-minimae*; sativa: *P. aestivalis.* MELAMPYRUM arvense, cristatum, saxosum: *P. melampyri.* MELILOTUS alba, officinalis: *P. aestivalis.* METHA longifolia: *P. stigmaticola.* MEUM athamanticum: *Pl. umbel.* MOEHRINGIA trinervia: *P. arenariae.* MYCELIS muralis: *B. lact.* MYOSOTIS alpestris, arvensis arvensis, discolor discolor, ramosissima ramosissima, scorpioides, sparsiflora, stricta, sylvatica sylvatica: *P. myosotidis.* NASTURTIUM officinale: *P. paras.* NESLIA paniculata s.l.: *A. cand., P. paras.* NICOTIANA alata, ipomopsifolia, langsdorfii, longiflora, nodiflora, paniculata, suaveolens, tabacum: *P. tabacina.* ODONTITES verna s.l.: *Pl. densa.* OENANTHE silaifolia: *Bl. baudysii.* ONOPORDON acanthium, tauricum: *B. lact.* PAPAVER dubium: *P. arborescens*; hybridum: *P. cristata*; rhoeas, somniferum: *P. arborescens.* PASTINACA sativa: *Pl. umbel.* PELTARIA alliacea: *P. paras.* PETROSELINUM crispum: *Pl. umbel.* PEUCEDANUM alsaticum, austriacum, palustre: *Pl. umbel.* PHYTEUMA vagneri: *P. phyteumatis.* PICRIS echioides, hieracioides s.l.: *B. lact.* PIMPINELLA major, saxifraga: *Pl. umbel.* PISUM sativum sativum: *P. viciae.* PLANTAGO altissima: *P. alta*; arenaria: *P. plantaginis*; cornuti, lanceolata: *P. alta*; major: *P. alta, P. plantaginis*; major intermedia, media s.l.: *P. alta.* POLYGONUM arenarium arenarium, aviculare: *P. polygoni.* PORTULACA oleracea oleracea, oleracea sativa: *A. portulacae.* POTENTILLA anserina: *P. sparsa*: aurea aurea, aurea chrysocraspeda: *P. potentillae*; reptans: *P. sparsa.* PRIMULA veris: *P. androsaces.* RANUNCULUS acris acris, acris strigulosus, bulbosus, cassubicus, carpaticus, constantinopolitanus, crenatus, ficaria, flammula: *P. ficariae*; illyricus: *P. illyrica*; lateriflorus, oreophilus, oxyspermus, pedatus, platanifolius, polyanthemos polyanthemos, pseudomontanus, repens, sardous: *P. ficariae.* RAPHANUS raphaniastrum raphaniastrum: *A. cand., P. paras.*; raphaniastrum landra: *P. paras.*; sativus: *A. cand., P. paras.* RAPISTRUM perenne: *P. paras.* RESEDA lutea, phyteuma: *P. crispula.* RHINANTHUS alpinus, angustifolius, minor: *Pl. densa*; rumelicus: *P. melampyri, Pl. den-*

sa; wagneri: *Pl. densa*. ROCHELIA disperma retorta: *P. rocheliae*. RORIPPA amphibia: *A. cand.*, *P. paras.*; x armoracioides: *P. paras.*; austriaca, islandica: *A. cand.*, *P. paras.*; pyrenaica: *A. cand.*; sylvestris sylvestris: *A. cand.*, *P. paras.*; sylvestris kerneri: *A. cand.* ROSA gallica: *P. sparsa*. RUBUS caesius, canescens, hirtus, idaeus: *P. sparsa*. RUMEX acetosa, acetosella, alpestris, tuberosus tuberosus: *P. rumicis*. SALSOLA kali s.l., kali ruthenica: *P. vistulensis*. SANGUISORBA minor: *P. sparsa*. SANICULA europaea: *Pl. umbel*. SCABIOSA columbaria columbaria: *P. knautiae*; columbaria s.l.: *P. violacea*; lucida lucida, ochroleuca: *P. knautiae*. SCLERANTHUS annuus, uncinatus: *P. scleranthi*. SCORZONERA cana, hispanica, laciniata: *A. trag*. SCROPHULARIA nodosa, scopoli: *P. sordida*. SENECIO aquaticus barbareifolius, squalidus, subalpinus: *B. lact.*; vernalis: *A. trag.*, *B. lact.*; vulgaris: *B. lact*. SERRATULA tinctoria: *A. trag*. SETARIA italica, verticillata, viridis: *S. graminicola*. SHERARDIA arvensis: *P. sherardiae*. SILAUM silaus: *Pl. umbel*. SILENE alba, noctiflora, otites: *P. melandrii*. SINAPIS alba, arvensis: *A. cand.*, *P. paras*. SISYMBRIUM altissimum, loeselii, officinale, orientale, polymorphum: *A. cand.*, *P. paras.*; strictissimum: *P. paras*. SIUM latifolium: *Bl. baudysii*. SMYRNIUM perfoliatum: *Pl. umbel*. SONCHUS arvensis s.l., arvensis uliginosus, asper, asper glaucescens, oleraceus, palustris: *B. lact*. SPERGULA arvensis: *P. obovata*. SPERGULARIA marina, media: *A. caryophyllacearum*, *P. obovata*; rubra: *P. obovata*. SPINACIA oleracea: *P. farinosa*. STACHYS palustris: *P. lamii*. STELLARIA holostea: *P. parva*; media s.l.: *alsinearum*. SYMPHYTUM cordatum, nodosum, officinale s.l., officinale uliginosum, ottomanum: *P. symphyti*. SYRENIA cana: *A. cand.*; montana: *A. cand.*, *P. paras*. TANACETUM vulgare: *P. leptosperma*. TARAXACUM 'officinale': *B. lact*. TETRAGONOLOBUS maritimus: *P. tetragonolobi*. THLASPI arvense, perfoliatum: *A. cand.*, *P. paras*. TRAGOPOGON dubius: *A. trag.*, *Pl. sphaerosperma*; porrifolius, pratensis s.l.: *A. trag*. TRIBULUS terrestris: *P. tribulina*. TRIFOLIUM alpestre, arvense, badium, campestre, dubium, echinatum, hybridum s.l., hybridum elegans, medium s.l., medium banaticum, montanum, pratense, repens, spadiceum, striatum: *P. trifoliorum*. URTICA dioica, kioviensis: *Ps. urticae*; urens: *P. debaryi*. VALERIANA officinalis: *P. valerianae*. VALERIANELLA dentata, lasiocarpa, locusta, pumila, rimosa: *P. valerianellae*. VERBASCUM banaticum, blattaria, densiflorum, glabratum glabratum, nigrum s.l., phlomoides, speciosum, thapsus s.l., thapsus crassifolium: *P. sordida*. VERONICA anagallis-aquatica, anagalloides: *P. grisea*; arvensis, austriaca teucrium: *P. sordida*; beccabunga, catenata: *P. grisea*; chamaedrys s.l., hederifolia: *P. sordida*; officinalis: *P. grisea*; persica, polita, praecox, prostrata: *P. sordida*; scardica, scutellata, serpyllifolia serpyllifolia, serpyllifolia humifusa, spicata spicata, urticifolia: *P. grisea*. VICIA angustifolia, cracca, grandiflora: *P. viciae*; hirsuta: *P. ervi*; lathyroides, lutea lutea, narbonensis, pannonica s.l., pannonica striata, peregrina, pisiformis, sativa, sepium, tetrasperma, villosa: *P. viciae*. VIOLA arvensis, kitaibeliana, tricolor tricolor: *P. violae*. VITIS vinifera sylvestris, vinifera vinifera, vinifera x American species: *Pl. viticola*. XANTHIUM ? italicum, strumarium: *Pl. halstedii*. XERANTHEMUM annuum: *A. trag.*, *B. lact.*; cylindraceum: *A. trag*. ZIZIPHORA capitata: *P. lamii*.

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SARCINULELLA BANKSIAE GEN. ET SP. NOV., A COELOMYCETE WITH A UNIQUE METHOD OF CONIDIAL DISPERSAL

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SUMMARY

Sarcinulella banksiae gen. et sp. nov. is described and illustrated from bark of *Banksia integrifolia* collected in Queensland. The genus is characterized by pycnidial conidiomata and phialidic hyaline aseptate conidia. Tendrils issuing from the ostiole are comprised of catenate sacci of mucilage each containing 40 or more conidia. The individual sacci retain their integrity during dispersal. Periphyses lining the base of the ostiolar channel are thought to be involved in saccus formation.

Amongst many interesting collections of microfungi made in Queensland following the XIII International Botanical Congress in Sydney, Australia, 1981, was a minute coelomycete. This proved to have a conidial dispersal method previously unknown in the Deuteromycotina.

Sarcinulella gen. nov.

(etym. *sarcinula* (L) - a little pack or bundle + *ella* (L) diminutive)

Mycelium immersum. Conidiomata conica, separata, superficialia vel semi-immersa, atro brunnea vel nigra; parietes crassi, ex textura angulari brunnea sed in regione ostioli ex textura porrecta verticali compositi; ostiolum centrale, circulare, canali cylindrico ad basim periphysibus instructi. Conidiophora absentia. Cellulae conidiogenae discretae, determinatae, hyalinae, cylindricae, canalibus apicalibus phialidicis conspicuis, spissescentibus periclinalibus distinctis sed collis notatis absentibus , ex parietibus basalibus et lateralibus conidiomatorum formatae. Conidia phialidica, hyalina, aseptata, laevia, (1)-2 guttulata, ellipsoidea; plus 40 conidia in saccis cylindricis aggregata, in catenis longis nonramosis e ostiolo emergentia.

Sp. typ. *S. banksiae*

Mycelium immersed. Conidiomata conical, separate, superficial to semi-immersed, dark brown to black; walls thick, of brown textura angularis except in the ostiolar region which is of vertically-orientated textura porrecta; ostiole central, circular, with a cylindrical channel, the base of which is lined with periphyses. Conidiophores absent. Conidiogenous cells discrete, determinate, hyaline, cylindrical, each with an apical phialidic aperture, channel, and periclinal thickening but without a collarette, formed from the basal and lateral walls of the conidiomata. Conidia phialidic, hyaline, aseptate, smooth (1)-2 guttulate, ellipsoid; 40 or more grouped in cylindrical sacci which emerge from the ostiole in long unbranched chains.

Sarcinulella banksiae sp. nov.

Mycelium immersum. Conidiomata conica vel fere rostrata, separata, superficialia vel semi-immersa, atro brunnea vel nigra, laevia, nitida, usque ad 90 um diam x 150 um alta; parietes 15 um crassi, ad basim stratum exteriorius ex textura angulari medio brunnea, 4-5 cellulis crassis et stratum interiorius ex textura angulari pallide brunnea, usque ad 10 cellulis parvioribus crassis, faciebus ex textura angulari fuscioribus; canalis ostioli cylindricus, 7-8 um diam, textura porrecta verticaliter disposita brunnea circumcinctus, apicem versus pallidiore hyphis plus separatis; periphyses hyalinae, deminutae, aseptatae, 10-12 x 1 um in fimbria ad basim canalis ostioli in lumen conidiomatis projectae; ostiolum singulum, circulare, centrale, apicibus libris hypharum texturae porrectae fimbriatum, 7-10 um diam. Conidiophora absentia. Cellulae conidiogenae discretae, determinatae, hyalinae, cylindricae, raro lageniformes, 4.5-7 x 2-3 um, canalibus apicalibus phialidicis conspicuis,

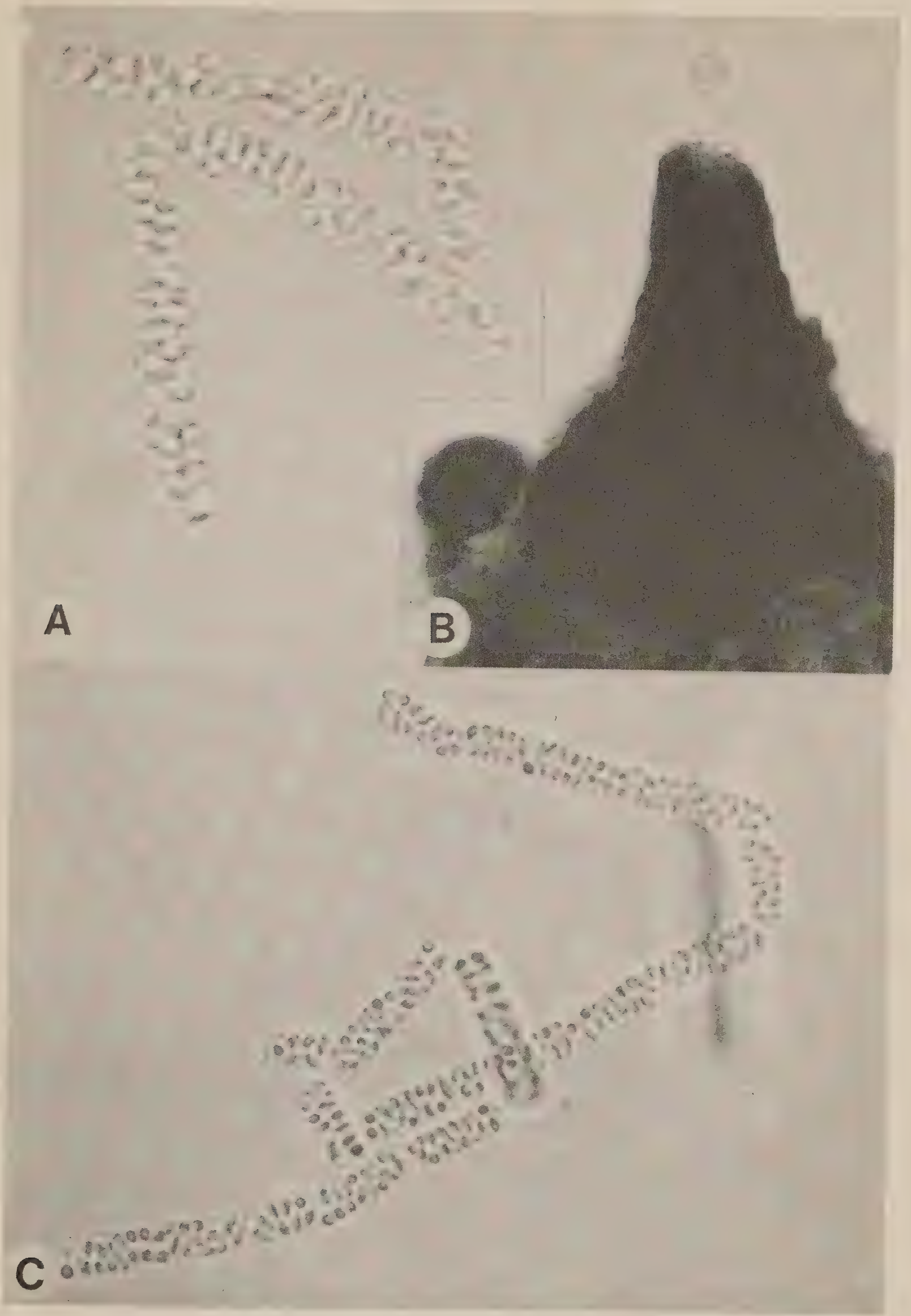

Fig. 1. *Sarcinulella banksiae*. A, vertical median section of a conidioma; B, conidia; C, conidiogenous cells lining the inner face of the conidiomatal wall; D, ostiolar region of conidioma with emerging sacci; E, vertical section of ostiolar region; F, chain of sacci. D–F, conidia in sacci depicted at varying optical levels.

spissescentibus periclinalibus distinctis sed collis notatis absentibus, ex parietibus basalibus et lateralibus conidiomatorum formatae. Conidia 4-6 x 2-2.5 um, phialidica, hyalina, aseptata, laevia, saepe 2-guttulata, raro 1-guttulata, ellipsoidea; plus 40 conidia in saccis cylindricis, 14-21 x 8.5-9 um aggregatis, usque ad 20 in catenis longis non ramosis e ostiolo emergentia.

In corticis emortuis *Banksiae integrifoliae*, Peregian Beach, Queensland, Australia, B.C. Sutton & J.L. Alcorn, 29 Aug. 1981, holotypus IMI 263392*b*; isotypus BRIP 13683.

Mycelium immersed. Conidiomata conical to almost rostrate, separate, superficial to semi-immersed, dark brown to black, smooth, shining, up to 90 um wide x 150 um high; walls several cells thick, 15 um wide, at the base composed of an outer layer 4-5 cells thick of medium brown textura angularis and an inner layer up to 10 cells thick of pale brown smaller-celled textura angularis, at the sides of darker textura angularis; the ostiolar channel is cylindrical, 7-8 um diam, and bounded by vertically orientated brown textura porrecta which becomes paler, with the hyphae more separated, towards the apex; at the base of the ostiolar channel a fringe of hyaline, tapered, aseptate periphyses, 10-12 x 1 um, project into the lumen; ostiole 7-10 um diam, single, circular, fringed by the free apices of the hyphae forming the textura porrecta. Conidiophores absent. Conidiogenous cells discrete, determinate, hyaline, cylindrical, more rarely lageniform, 4.5-7 x 2-3 um, each with an apical phialidic aperture, channel, and periclinal thickening but no collarette, formed from the basal and lateral walls of the conidiomata. Conidia 4-6 x 2-2.5 um, phialidic, hyaline, aseptate, smooth, often 2-guttulate, occasionally 1-guttulate, ellipsoid; 40 or more conidia are grouped into cylindrical sacci, 14-21 x 8.5-9 um, which emerge from the ostiole in long, unbranched chains comprising up to 20 individual sacci.

DISCUSSION

In conidial morphology, conidiogenesis and some aspects of conidiomatal structure *Sarcinulella* differs little from many of the known genera of coelomycetes (Sutton, 1980). Conidia are comparatively small, unicellular and hyaline; they are formed from short cylindrical conidiogenous cells which show a typical apical phialidic apparatus. The conidiomata are pycnidial with a single locule and walls are several cells thick. It is in the organization of the ostiolar tissues and the method of dispersal of conidia that *Sarcinulella* is quite unusual.

Comparatively few genera of coelomycetes have rostrate conidiomata in which the walls surrounding the ostiolar channel are of textura

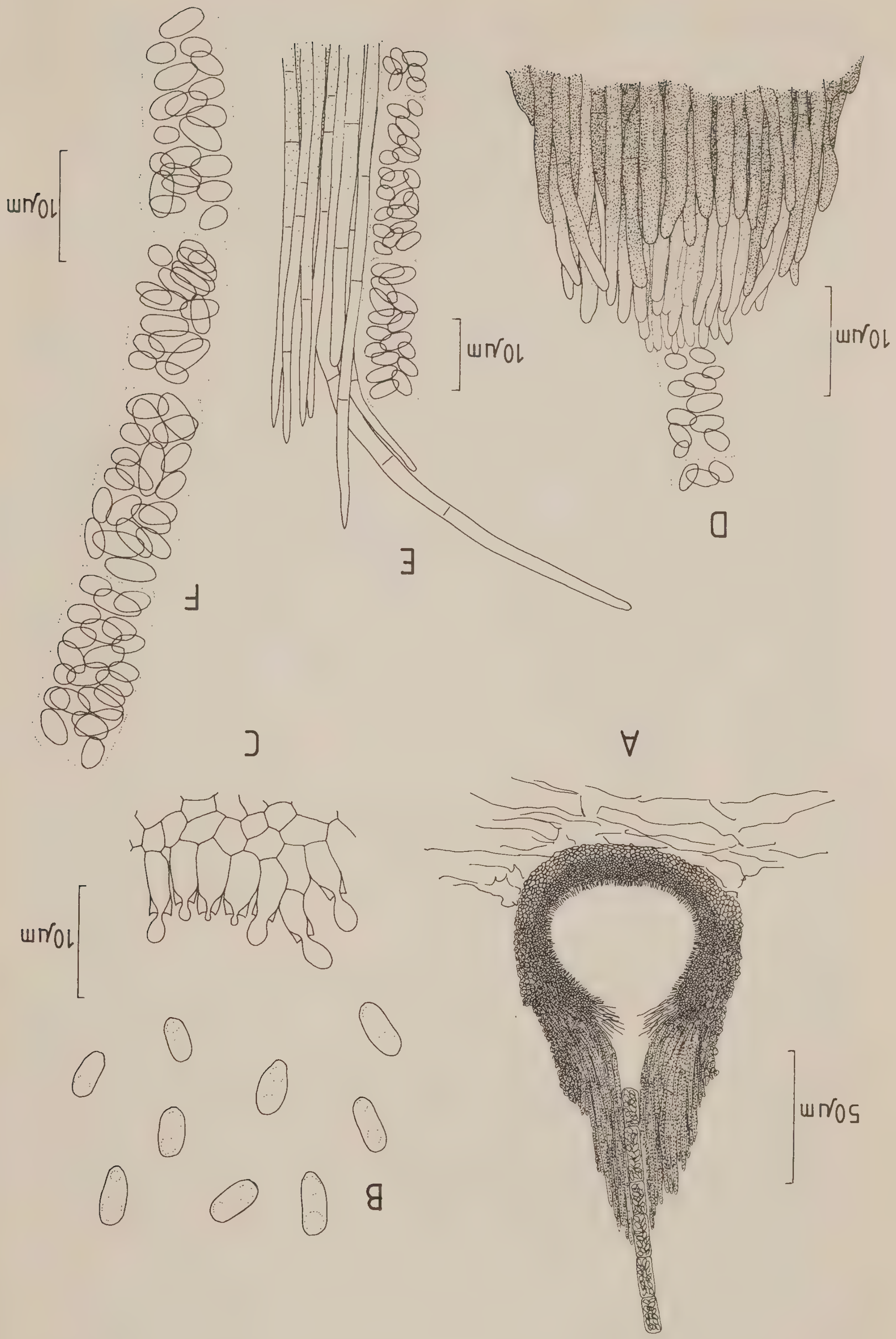

Fig. 2. *Sarcinulella banksiae.* A,C, chains of sacci containing conidia (A, x 1000; C, x 650); B, ostiolar region of conidioma with emerging sacci (x 650).

porrecta (Sutton, 1973, 1975, 1980). It is only in *Nanoschema* Sutton and *Cornucopiella* Höhn. where loose textura porrecta forms the upper part of the conidioma and even in these genera the ostiole and ostiolar channel are not well-differentiated. In *Sarcinulella* the channel is up to 65 um long and the tissue surrounding it becomes progressively less compact towards the apex though still retaining its structural integrity. This results in an ostiolar channel of constant diameter throughout its length. At the base of the channel a fringe of short sterile periphyses projects into the lumen. Although paraphyses interspersed with conidiophores are documented for a few genera of coelomycetes (Sutton, 1980 ; Nag Raj, 1981), periphyses are even less frequent. Nag Raj & DiCosmo (1978) report the ostiole in *Melanconiopsis inquinans* Ell. & Ev. as lined with simple or branched, septate, subhyaline, smooth-walled, sterile hyphae invested in a mucilaginous matrix. Apart from this example *Sarcinulella* appears to be the only other coelomycete in which such sterile elements have been confirmed.

The mechanism of conidial dispersal in *Sarcinulella* is quite remarkable. The majority of coelomycetes produce conidia in slimy mucilaginous material, and under suitable conditions of temperature and especially humidity, the conidia suspended in the mucilage are dispersed through the ostiole, raphe, irregular tear or overlying host tissues in either distinct tendrils (as in *Cytospora* Ehrenb.: Fr. or *Libertella* Desm.) or in effuse or compact conidial masses (as in *Phoma* Westd. and *Melanconium* Lk: Fr.). The common features of these different modes of dispersal is that the conidia lie at random and are not particularly orientated in any direction in the supporting mucilaginous material. On mounting conidial tendrils or masses in aqueous or phenolic preparations, the mucilage dissipates, thus allowing the conidia to become scattered. In *Sarcinulella* however, the conidia fill the conidiomatal locule and subsequently become aggregated into groups of 40 or more in the ostiolar channel after passing the periphyses. The individual sacci of conidia emerge from the ostiole in long unbranched chains which, even under the dissecting microscope, can be seen as quite different from normal conidial tendrils because of their segmented appearance. When chains are prepared in aqueous or phenolic mountants they may break at the junctions between sacci but the individual sacci do not lose their integrity. Erythrosin, acid fuchsin, trypan blue and cotton blue fail to stain either the mucilaginous sacci or the contained conidia.

It seems most probable that the periphyses are involved either in production of mucilage or the chemical modification of mucilage formed in the conidiomatal locule because sections of conidiomata always show the locule to be filled to capacity with conidia, and these are randomly distributed. It is only after passing the lining of periphyses that a) the conidia become aggregated into sacci and b) the mucilage becomes altered to form the rigid cylindrical matrix in which the conidia are held. The diameter of the ostiolar channel clearly imposes a structural limitation on the width of the conidial sacci, but the mechanism(s) regulating the length of sacci is not known. Conidial sacci vary from 14 to 21 um in length and a combination of temperature, humidity and diurnal periodicity may be involved in determining not only the numbers of conidia produced but also the length of the sacci.

Reports of the aggregation of conidia in this very precise manner have not so far been made for any genera of coelomycetes or hyphomycetes other than *Sarcinulella*. To differentiate this type of arrangement from that known in the majority of slimy-spored coelomycetes and many hyphomycetes, and from production of strong and weak chains of connected and disconnected conidia (Minter et al., 1982, 1983), it is proposed to introduce the term *saccus* (sac, L). This describes the individual cylindrical packets of conidia bound in rigid mucilaginous material. They are distinct from the random suspension of conidia in mucilaginous tendrils or effuse masses formed by other fungi, and which vary according to the humidity to which the fungus may have been subjected.

The sacci in *Sarcinulella* raise interesting questions concerning production of conidia, their dispersal and germination, and the establishment of new mycelium capable of forming conidiomata. What is the composition of the mucilaginous matrix in which conidia are dispersed and how does it differ from that in other coelomycetes and hyphomycetes? How and where is it formed? What factors determine the length of the sacci and the number of conidia included in each saccus? Initial formation of conidia from phialides is accompanied by production of normal mucilage but the elements for dispersal, the sacci, may well be dry and are presumably dispersed by wind. It is possible that the sacci may be moist and therefore sticky if humidity is high. Do these factors give an increased survival value to this method of dispersal, and if so why is it apparently unique? Once the sacci have been dispersed how is the matrix broken down and what proportion of conidia are capable of germination? Such questions cannot be effectively answered unless more material is obtained and the organism is brought into culture and stimulated to sporulate. Further efforts in these directions are being made.

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CULTURAL STUDIES IN HYPOCHNICIUM
(CORTICIACEAE, BASIDIOMYCETES)

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ABSTRACT: Hypochnicium karstenii (Bres.) Hallenb. nov. comb. is segregated from H. bombycinum (Sommerf. ex Fr.) John Erikss. on the basis of incompatibility.
The closely related species H. eichleri (Bres.) Erikss. & Ryv. and H. punctulatum (Cke) John Erikss. are found to be incompatible.

Hypochnicium bombycinum (Sommerf. ex Fr.) John Erikss. has been treated as one taxon with a noticeable internal variation (Erikss. & Ryv., 1976): The hymenium may be smooth to more or less tuberculate or even irpicoid and the spores may be characteristically ovoid or ellipsoid - - subglobose. In. N. Europe, this variation in morphology seems to be correlated to the occurrence on different kinds of substrates.

Specimens collected on Pinus or Picea have membranaceous fruitbodies and a high ratio of ellipsoid-subglobose spores compared with the ovoid spore shape. Such specimens have been described as H. bombycinum var. pinicola Lundell (Lundell & Nannfeldt, 1941).

The collections from deciduous wood are usually more crustaceous and varyingly tuberculate. Spores with an ovoid shape are almost as common as ellipsoid-subglobose ones. No other differences in basidiocarp morphology have been found. For further descriptions of these taxa, see Eriksson and Ryvarden (1976).

In the present study it is shown that var. pinicola is incompatible with var. bombycinum and thus represents an independent species. Hypochnicium bombycinum var. pinicola has earlier incorrectly been referred to Corticium molle Fr. (Karsten, 1882) - a species nowadays placed in Leucogyrophana. Bresadola (1911) noticed this missapplication and described Corticium karstenii Bres. as a new species.

Hypochnicium karstenii (Bres.) Hallenb. n. comb. is herewith proposed as a new combination. Basionym: Corticium karstenii Bres., Ann. myc. 9: 427 (1911).

Holotype: Mustiala, in corticem Pini, Karsten (S).

Holotype of H. bombycinum (Sommerf. ex Fr.) John Erikss. is the following specimen: Thelephora bombycina, Saltdalen ("Saltadalen"), in cortice subputr. Alni 11/23, Sommerfelt (O).

A closer investigation of the variation in spore size and shape has been made (Fig. 1).

In H. karstenii the spores are 7—10x6.5—9.5 µm, average 8.7x7.6 µm; in H. bombycinum 7.5—11x6—7.5 µm, average 8.7x6.3 µm.

In H. karstenii, the ratio ellipsoid/ovoid spores varies between 2.0—4.3; in H. bombycinum 1 — 1.3.

In the tests for extracellular oxidases, H. karstenii gave negative results, thus differing clearly from H. bombycinum. Concerning other cultural characteristics, no noticeable differences could be found.

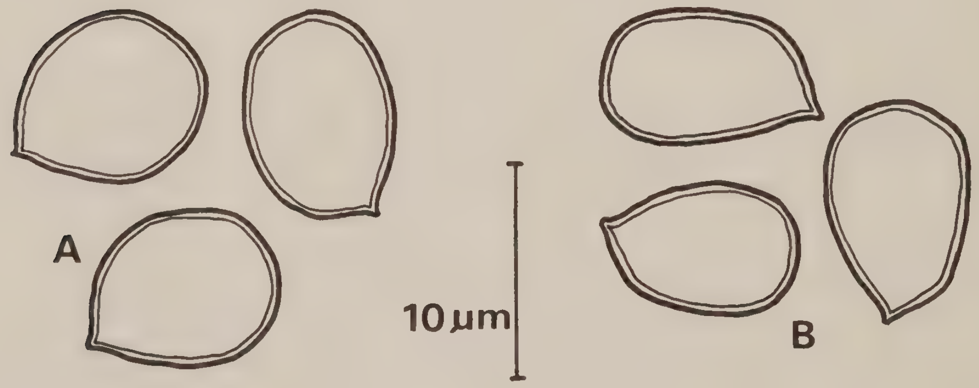

Fig. 1. A) Ellipsoid - subglobose spores in Hypochnicium karstenii GB 79. B) Ovoid spores in H. bombycinum. GB 253.

MATERIALS AND METHODS. Monosporous mycelia have been obtained from the following specimens:

Culture no.	
GB 37	Hypochnicium bombycinum/Sweden, Västergötland, Göteborg Botanical Garden/1974–08–15/ T. Hallingbäck.
GB 253	H. bombycinum/Sweden, Torne Lappmark, between Björkliden and Abisko/On a leaning log of Salix/ 1981–08–11/ N. Hallenberg 3766.
GB 66	H. karstenii/Denmark, Jutland, Mols Bjerge, N. of Tinghulen/On a leaning log of Pinus/1979–10–16/ N. Hallenberg 3153.
GB 79	H. karstenii/Sweden, Östergötland, Omberg, Storpissan nature reserve/1979–11–09/ K. Hjortstam 11301.

Two monosporous mycelia from each specimen were crossed in all combinations. The mycelia were checked for the presence of clamps since they had been in contact with each other for 4 weeks.

	GB 37/1	GB 37/2	GB 66/1	GB 66/2	GB 79/1	GB 79/2	GB 253/1	GB 253/2
GB 37/1		–	–	–	–	–	+	+
GB 37/2			–	–	–	–	+	+
GB 66/1				+	+	+	–	–
GB 66/2					+	+	–	–
GB 79/1						–	–	–
GB 79/2							–	–
GB 253/1								–
GB 253/2								

CULTURAL CHARACTERISTICS FOR H. BOMBYCINUM (GB 253).

Margin submerged, mat appressed, aerial mycelium absent; hyphae with clamps, ordinarily branched, thin-walled, 2–5 µm in diam.

NOBLES' CODE (Nobles 1965, with emendations by Boidin, 1966):

2a. (2b). 3c. 7. 32. 36. 38. 45. 54. 58. 61.

OXIDASE REACTIONS:

gallic acid	+	tyrosine	-
guaiacol	+++	para-cresol	L (milk white)

Gradation according to Boidin (1958).

The number of monosporous mycelia present in 37 and 253 was too small to evaluate the polarity: Boidin (1956) reports *H. bombycinum var. irpicoides* Bourd. & Galz. as tetrapolar. Confrontations between the latter and GB 37, 66, and 253 gave negative results. However, the still present strain of *H. bombycinum var. irpicoides* (LY 1402/C) was probably too old to allow any conclusions about the compatibility.

CYTOLOGY: Spores are uninucleate, monosporous mycelia uninucleate, and polysporous mycelium regularly dicaryotic. Staining methods according to Boidin (1958).

CULTURAL CHARACTERISTICS FOR H. KARSTENII (GB 66).

The investigated polysporous mycelium was made artificially by inoculating the 6 available monosporous mycelia on the same plate. Nodose-septate mycelium was isolated after 4 weeks.

Margin submerged, mat appressed, aerial mycelium sparsely present, downy; hyphae with clamps, ordinarily branched, thin-walled, 2–7 µm in diam.

NOBLES' CODE;

1. 3c. 7. 32. 36. 38. 44. 55. 60. 61.

OXIDASE REACTIONS: No staining occurred in media containing gallic acid, guaiacol, tyrosine or para-cresol. However, when drop-tests (according to Currie D. Marr, 1979) were used, a very weak staining occurred with guaiacol and 1-naphtol (after 2 hours). More oxidase tests with true polysporous mycelia ought to be done to make this result more certain.

POLARITY: A_1B_1: 1 A_2B_1: 3, 5, 6
A_1B_2: 4 A_2B_2: 2

CYTOLOGY: Spores are uninucleate, monosporous mycelia uninucleate.

--- ooo ---

Hypochnicium eichleri (Bres.) Erikss. & Ryv. is very close to *H. punctulatum* (Cke) John Erikss. Compatibility tests between the species have long been desired to ascertain their independency from each other. Eriksson and Ryvarden (1976) keep them apart on the following basis:

H. eichleri has a spore size of 8–10(–12)x6–7(–7.5) µm; the main distribution area in Europe is in the N. parts.

H. punctulatum has spores of a smaller size (5–)5.5–6.6 (–7.7)x4.5–5 µm. It is widely distributed in C. Europe and with very few records in the N. parts.

Both species have been collected on coniferous as well as deciduous wood. For further descriptions of the species, see Eriksson and Ryvarden (1976).

In this study it is shown that *H. eichleri* is incompatible with *H. punctulatum*. *H. punctulatum* is found to be heterothallic and tetrapolar, while *H. eichleri* seems to be homothallic. Further, the culture tests show that the mycelium in *H. punctulatum* grows faster than in *H. eichleri*. Hyphal tips in *H. eichleri* are partly sulfo-positive, while not stained at all in *H. punctulatum*.

MATERIAL AND METHODS. The following specimens were used in culture tests:

Culture no.	
GB 29	*Hypochnicium eichleri*/Sweden, Västergötland, Göteborg, Rya Skog nature reserve/1973–12–11/ T. Hallingbäck.
GB 269	*H. eichleri*/Sweden, Torne Lappmark, Jieprenjåkk/ On a fallen brown-rotted log of Betula/1981–08––09--10/ N. Hallenberg 3688.
GB 160	*H. punctulatum*/Denmark, Lolland, Fuglesang Storskov/On a fallen log of Abies/1980–09–18/ N. Hallenberg 3406.

5 monosporous cultures from 269 were regularly clamped and dicaryotic after 7 weeks, as well as the only one available from GB 29. This indicates that *H. eichleri* might be homothallic.

The identity of *H. eichleri* as a species distinct from *H. punctulatum* is confirmed by di-mon tests between clamped, dicaryotic cultures from *H. eichleri* and monosporous, haploid cultures from *H. punctulatum*:

Dicaryotic x haploid cultures

GB 29/1 x GB 160/2 = -
GB 269/1 x GB 160/1 = -
GB 269/1 x GB 160/4 = -
GB 269/2 x GB 160/1 = -
GB 269/2 x GB 160/4 = -

In all confrontations clamps were completely absent in the haploid side and a barrier zone was developed between the mycelia.

CULTURAL CHARACTERISTICS FOR H. EICHLERI (GB 269).

Mat appressed, downy; hyphae with clamps at all septa, ordinarily branched, thin-walled, in the margin 4–7.5 µm in diam., in old parts of the mycelium 2–8 µm in diam., partly widened to gloeocystidium-like structures, up to 50x8 µm. After 6 weeks growth on an agar plate, some parts of the hyphae were sulfo-positive – especially the hyphal tips.

CYTOLOGY: Spores uninucleate, monosporous mycelia dicaryotic.

NOBLES' CODE:

2a. (2b). 3c. (7). (26). 32. 36. 38. 47. 54. 55. (57).

OXIDASE REACTIONS:

gallic acid	+++	tyrosine	-
guaiacol	++++	para-cresol	L

CULTURAL CHARACTERISTICS FOR H. PUNCTULATUM (GB 160).

Margin submerged, mat appressed, aerial mycelium downy; hyphae with clamps, 2–5 µm in diam., the wider hyphae straight, sparsely septated, from them branching densely ramified, narrow hyphae. In old parts of the mycelium some hyphae are irregularly widened, forming gloeocystidium-like structures, 22–42x5–8 µm. All parts of the mycelium are sulfo-negative.

POLARITY: A_1B_1: 1 A_1B_2: 4
A_2B_1: 3 A_2B_2: 2

CYTOLOGY: Spores uninucleate, monosporous mycelia with uninucleate cells, polysporous mycelia dicaryotic.

NOBLES' CODE:

2a. 3c. 26. 32. 36. 38. 45. 54. 55. 60. 61.

OXIDASE REACTIONS:

gallic acid	+++++	tyrosine	-
guaiacol	++++	para-cresol	-

DISCUSSION. Both *Hypochnicium karstenii* and *H. punctulatum* are tetrapolar. This is in accordance with previous results in the genus, i.e. *H. bombycinum* var. *irpicoides* Bourd. & Galz. (Boidin, 1956), *H. cystidiatum* Boid. & Gilles (Boidin and Lanquetin, 1971), and *H. vellereum* (Ell. & Crag.) Parm. (Nobles and Nordin, 1955). On the contrary, it is indicated that *H. eichleri* is homothallic. Hyphal tips in cultivated mycelium of *H. eichleri* were found to be sulfo-positive – a reaction previously found only in the basidiocarps (gloeocystidia) of *H. analogum* (Bourd. & Galz.) John Erikss. within the genus.

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NOTICE

MSA PLANS FOR IMC^3

The Mycological Society of America has announced their appointment of Garber Travel, Box 404, Brookline, MA 02146 as their official agents for travel arrangement to the Third International Mycological Congress to be held in Tokyo, Japan, August 28-September 3, 1983. A brochure is available detailing a Congress Program (August 26-September 4th) only, a Congress and Japan Pre-tour (August 20-September 4th), and a Congress and China Pre-tour (August 18-September 4th). Connections for those also planning on attending the Fourth International Congress on Plant Pathology in Melbourne, Australia, in August are also arranged by Garber Travel. Because of airline pricing, air fares for the Congress Program alone are higher ($1413) than for the Congress plus Japan Pre-tour ($961) or the Congress plus China Pre-tour ($1196). For those who wish to stay in Japan beyond 14 days, Garber Travel will arrange an APEX air fare of $930. (All prices based on West Coast departures.)

The Mycological Society of America will also be awarding a limited number of Travel Grants, each in the amount of $500, to qualified members of the Society attending and participating in the Tokyo meetings. Particulars concerning elegibility and dates of application will be announced in mid-January, 1983, by Dr. R. L. Shaffer, Chairman, MSA Travel Awards Committee for IMC^3, The Herbarium, University of Michigan, Ann Arbor, MI 48109, in a mailing to MSA members residing in the U.S. Should MSA members not have received information on application procedures by mid-February, they should write to Dr. Shaffer directly.

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Page 381, last line: *for* 637. *read* 367.

ERRATA, VOLUME FOURTEEN

14(2) cover line 27: *for* 1981 *read* 1982

ERRATA, VOLUME FIFTEEN

Page 197, *add:* leaves of Ammophila arenaria, 17.VII.1963, leg. O.E. no. 2160p (S).
Pages 529, 530: omitted

ERRATA, VOLUME SIXTEEN

Page 35,	line 23:	for *S.* read *Stenella*
80	13:	for *C.* read *Cercoseptoria*
153	35:	for *S.* read *Sclerotinia*
174	44:	for *P.* read *Polyporus*
176	10:	for *P.* read *Polyporus*
180	18:	for *subsperpens* read *subserpens*
204	38:	for *P.* read *Pseudocyphellaria*
233	12:	for *Sp.* read *Sporotrichum*
	28:	for *S. schenkii* and *Sp.* read *Sporothrix schenkii* and *Sporotrichum*
234	11:	for *Sp.* read *Sporotrichum*
235	23:	for *S.* read *Sporothrix*
236	1:	for *Sp.* read *Sporotrichum*
278	38:	for *E.* read *Erynia*
282	38:	for *E.* read *Entomophthora*
	39:	for *E.* read *Erynia*
283	33:	for *grylly*-type, *E.* read *grylli*-type, *Erynia*
284	28, 32:	for *E.* read *Entomophthora*
286	3:	for *E.* read *Entomophthora*
287	38:	for *E.* read *Erynia*
293	13:	for *tuberculatum* read *tuberculosum*
297	7:	for *F.* read *Fomes*
333	20:	for *THE PYTHIUM* read *THE GENUS PYTHIUM*
462	27, 33:	for *E.* read *Epithele*
464	4:	for *effibulata* read *efibulata*
472	34:	for *E.* read *Epithele*
473	41:	for Hypodontia read Hyphodontia
492	34:	for *Conforticium* read *Conferticium*

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